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GEOLOGICAL SURVEY OF CANADA
ROBERT BELL, M.D., Sc.D., LL.D., F.R.S., Acting Director.

MESOZOIC FOSSILS

VOLUME I

MUS. COMP. ZOOLOGY
CAMBRIDGE, MASS.

— BY —

J. F. WHITEAVES, LL.D., F.G.S., F.R.S.C., Etc.

Palæontologist, Zoologist, and Assistant Director.

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The present volume, as now completed, consists of five descriptive and illustrated Reports upon the fossils of the Cretaceous rocks of the Queen Charlotte and Vancouver islands.

Part I, consisting of pages 1 to 92 and plates 1 to 10 (in each case both inclusive) with map, was published in 1876: Part II, of pages 93–190 and plates 11–20, in 1879; Part III, of pages 191–262 and plates 21–32, in 1884; and Part IV, of pages 263–308 and plates 33–39, in 1900.

The part now submitted (Part V) which concludes the volume, and consists of pages 309–416 and plates 40–51, will bear date herewith.

ROBERT BELL.

Geological Survey Department,
Ottawa, July, 1903.

GEOLOGICAL SURVEY OF CANADA.
ALFRED R. C. SELWYN, F.R.S., F.G.S., DIRECTOR.

MESOZOIC FOSSILS.

VOLUME I.

PART I.—ON SOME INVERTEBRATES FROM THE COAL-BEARING ROCKS OF THE QUEEN CHARLOTTE ISLANDS,

COLLECTED BY MR. JAMES RICHARDSON IN 1872.

BY J. F. WHITEAVES, F.G.S.,

HONORARY MEMBER OF THE ASHMOLEAN SOCIETY, OXFORD.

MONTREAL:
PRINTED FOR THE GOVERNMENT OF CANADA.
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This publication is intended to contain descriptions and figures of some of the organic remains of the Mesozoic rocks of the Dominion.

The present Part is devoted to a monograph on the Invertebrata collected by Mr. James Richardson from the Coal-bearing rocks of the Queen Charlotte Islands, in the summer of 1872.

The figures, Plates I. to X., have been drawn from nature and lithographed by Mr. A. H. Foord, F.G.S., the artist to the Survey.

ALFRED R. C. SELWYN.

Geological Survey Office,
Montreal, *November 30th*, 1876.

GEOLOGICAL SURVEY OF CANADA.

10,039

MESOZOIC FOSSILS.

BY J. F. WHITEAVES.

VOLUME I.

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I. *On some Invertebrates from the Coal-Bearing Rocks of the Queen Charlotte Islands.*

INTRODUCTION.

The Queen Charlotte Islands, to which exclusive reference will be made in these pages,* are situated about half way between the Vancouver group and Sitka, at a distance of eighty or one hundred miles from the mainland of British Columbia. Their geographical position, as laid down on the British Hydrographic Charts, is between latitudes 51° 54′ and 54° 22′ north; and longitudes 131° and 133°† 07′ west. The credit of the first discovery of these islands has been incorrectly assigned to La Perouse, or Captain Dixon, in some of the older encyclopædias and gazetteers; nor are volumes of a much more recent date entirely free from similar errors. By far the most trustworthy account of the progress of discovery on the north-west coast of America yet published, is to be found at Part II., Chapter II., of Mr. W. H. Dall's able work, entitled "Alaska and its Resources." ‡ In answer to enquiries with reference to the authenticity or otherwise of supposed discoveries in this vicinity by Admiral Fuentes and others, and as to what was the vocation or rank of Juan Perez, Mr. Dall kindly forwarded the following historical sketch of the group, which, as it contains some unpublished facts and information which probably no other person could give, is gladly printed here, with his permission, and in his own words.

1. "The manuscript from which the so-called Voyage of Admiral Fuentes was made public, is now believed to be a forgery. It is certainly unsupported by any intrinsic evidences of truth, and is universally rejected by modern authors. The same remark will apply also to

* There is another group of the same name in the South Pacific.

† Printed 135°, by a typographical error, in Mr. Richardson's report.

‡ Boston: 1870.

Maldonado, and many of the early geographical fictions. Fuentes said that, half way through the north-east passage, into which he sailed he met a ship from Boston!"

2. "On the 25th of January, 1774, Ensign Juan Perez, formerly employed in the Manilla trade, sailed on the corvette *Santiago*, from San Blas, touching at Monterey, California, from which he sailed June 6th, on an exploring expedition to the north, accompanied by Pilot Estevan Martinez, and Rev. Fathers Pena and Crespi, chaplains. The first land seen, July 18, 1774, was that of the Queen Charlotte Islands, in latitude 54°, to the north point of which Perez gave the name of Co. de S. Margarita, and to the high mountains, Sierra de San Cristoval. Finding no anchorage, they turned southward without landing, and on the 9th of August anchored in Nootka Sound. The authorities for this voyage are the narratives of Perez, observations of Martinez, and the journal of Friar Pena, MSS. copies of which were obtained from the Imperial Archives of Madrid, by the United States Government, in 1840. An account was also published in 1802, in the introduction to the voyages of the 'Sutil and Mexicana.' This was the first voyage made northwards by the Spaniards after 1603."

3. "Immediately after the return of Perez, Viceroy Bucarelli ordered another expedition to examine the coast as far as latitude 65°. Captain Bruno Heceta, in charge of the *Santiago*, with Perez as Ensign, and the schooner *Sonora*, in charge of Juan de Ayala, with Maurelle as pilot, in company with the schooner *San Carlos*, sailed from San Blas, March 15, 1775. The Captain of the *San Carlos* became insane before they were out of sight of land, and Ayala was detached to take his place, and stopped at Monterey, while Lieutenant Francesco de la Bodega y Quadra took his place in charge of the *Sonora*. Most accounts are erroneous in stating that Ayala accompanied the expedition northwards. (The authorities for this voyage are the MSS. accounts prepared by order of the Spanish Government immediately after the conclusion of the expedition, of the official narrative of the whole, including the journal of Bodega, and of Maurelle, part of the journal of Heceta, and a concise narrative by Bodega. These are represented by duplicates obtained from Madrid, and now in our State Department Library. A synopsis was published in Galiano's preface to the voyage of the *Sutil* and *Mexicana* in 1802. Barrington's translation of part of the MSS. was made before the official revision, and includes many errors.) The schooner was attacked by the natives near Destruction Island, north of Cape Mendocino: and being very unwilling to proceed, Heceta, in the *Santiago*, (with Perez) seized

the opportunity to return to Monterey. Bodega and Maurelle in the schooner *Sonora*, however, kept on their way. They saw Mount Edgecumbe about the middle of August, and afterwards landed in Port Remedios (the Bay of Islands of Cook) and, sailing down the coast, named the strait north of Queen Charlotte Islands, Perez Inlet, and coasted along (without entering bays, or landing) the shores of the said islands. They then returned to Monterey, doing a little surveying on the Oregon and Californian coast on the way.

Subsequently, Cook did not see the Queen Charlotte Islands."

4. "In 1786, La Perouse coasted along the shore of the Queen Charlotte Islands, and was the first to suggest their separation from the mainland. (Arteaga and Bodega, in 1779, did not visit them.) La Perouse, about August 18, 1786, (Vol. I., page 422,) coasted along their shores, and named (on his chart) in the N. part, Baie de Clonard, a bay in the south part, Baie de la Touche, the south cape—Cape Hector, and some small islands off it, 'Isles Kerouart.' He sailed to the eastward sufficiently to satisfy himself that a deep inlet extended between the islands and the mainland. His Isles Fleurieu are on the main coast, S. and E. of the Queen Charlotte Islands, and are the Princess Royal Islands of Vancouver. He gave no name to the Queen Charlotte Islands."

5. "In 1786, Captains Lowrie and Guise visited the Queen Charlotte Islands coast, but left no information on record in regard to it."

6. "In August, 1787, Dixon coasted along these Islands, landing nowhere, and named them for the first time, also calling the strait north of them after himself. Captains Colnett and Duncan sailed from Nootka to trade at these islands about the same time, and the following year, Duncan sailed through the strait between the Islands and the mainland, which had been assumed by the previous voyagers. He also named the Fleurieu Islands (of La Perouse) the 'Princess Royal Islands,' after his vessel."

7. "In 1789, Captain Robert Gray, of the sloop *Washington*, of Boston, explored the east coast of the Queen Charlotte Islands, which had not previously been visited by any white man, though Duncan had sailed through the strait, keeping more on the mainland shore. Gray called it Washington Island, being ignorant of Dixon's name. Afterwards, Douglas, the colleague of Meares, also visited this east shore."

8. "On the 29th of June, 1790, Captain Joseph Ingraham, of the brig *Hope*, anchored in a harbour on the south-east side of the Queen Charlotte Islands, which he called Magee's Sound, after one of the owners of his

vessel. His MSS. journal is referred to by Greenhow." * He spent the summer on this coast, and is the first white man, whom we have any account of as actually landing on these islands. All previous voyagers and coasters, for fear of the natives, had contented themselves with standing off and on near the shores, or anchoring at a distance, and trading from their vessels.

9. "The *Columbia*, Captain Gray, made a second voyage from Boston in 1790-91, and was occupied trading and exploring on the east coast of the Queen Charlotte Islands in August and September, 1791. He wintered at Clayoquot, and built a small vessel, the *Adventure*, which, under Gray's mate Haswell, sailed from Clayoquot, in the spring of 1792, for the Queen Charlotte Islands, and Gray himself, later in the season, returned there for trade."

On August 22, 1791, Captain Etienne Marchand, in the French ship *Solide*, which had visited Sitka Sound, made the entrance of Cloak Bay, between North and Graham Islands. While the vessel stood off and on, a boat party entered and explored the bay and adjacent Cox Strait. The bay had been seen and named by Dixon, and had been traversed by Gray, who first identified North Island as an island. Douglas afterwards anchored there, and has given a brief description of his observations; but the first chart, in detail, published of any of the Queen Charlotte Island harbours, was that prepared by Marchand's party.

The *Solide* subsequently visited the west coast of Graham Island for some distance to the southward, and then departed for Berkeley Sound.

10. "In 1792, the Spanish corvette *Aransasu*, Lieutenant Jacinto Caamano, sailed from San Blas, and explored the main coast between 50° and 53° North Latitude, but it does not appear that he touched at the Islands, as he was seeking a North East passage."

11. "In 1794, Vancouver, returning to Nootka, coasted along the West shore of Queen Charlotte Islands, which he had previously surveyed superficially in September, 1793, but the voyage of 1794 added nothing to information previously obtained."

"I can assure you of the correctness of the preceding notes, as I have verified them carefully. So you can set it down as certain that Perez was the discoverer, and Ingraham probably the first to land. Later voyages are few and mostly *very* modern; these you are doubtless familiar with."

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* "History of Oregon and California and other Territories on the North-West Coast of North America." By Robert Greenhow. 2nd edition. Boston: 1845.

Although the existence of coal on these islands has been long known, it is by no means certain by whom, or at what date, the discovery was made. Openings have been made upon the anthracite seams of Graham Island at several different localities, under the auspices of the Queen Charlotte Coal Mining Company, but these operations do not appear to have been very remunerative, and they have subsequently been discontinued.

In the summer of 1872, Mr. Richardson, of the Canadian Geological corps, visited the group, and devoted nearly two weeks to as careful an examination of the geology of the country near Cowgitz, as the time would permit. He brought back with him an interesting collection of the fossils, rocks, minerals and economic products of that region, and published a somewhat detailed account of his investigations in the Report of Progress for 1872-73. The fossil plants collected on this occasion have been submitted to Principal Dawson, who has contributed some notes upon them as an appendix to the report just referred to, which contains also some remarks on the Cephalopoda by Mr. Billings.

The accompanying map has been prepared to show the distribution of the Coal-Bearing rocks of the region explored, the boundaries of the divisions, and the localities from which the fossils were collected. An arm of the sea, called Skidegate Channel, separates Moresby and Graham, the two largest of the Queen Charlotte Islands. The western half of Skidegate Channel is very narrow, but on its eastern side it widens out and includes several smaller islands. The map shows the central and widest part of this channel (with Maud, Lina and several other small islands), which is bounded on nearly three sides by Graham Island; and its eastern opening called Skidegate Inlet. A portion of Moresby Island is also seen in the lower right hand corner.

The following brief account of the geology of this district is either condensed from Mr. Richardson's report cited above, or is derived from information directly supplied by him.

The Coal-Bearing rocks of the area represented on the map form a trough or syncline, of which only the edges are visible at the surface. At its western extremity, and probably also to the eastwards, the syncline is bounded by trappean rocks. The following divisions have been proposed for these sedimentary deposits, but the thickness of each series has not yet been ascertained:

1. Lower Shales, with Coal and Iron Ore.
2. Coarse Conglomerates.
3. Upper Shales and Sandstones.

1. The Lower Shales.—These consist of highly fossiliferous argillaceous shales, containing a small percentage of calcareous matter, interstratified with greenish or greyish sandstones, which are also very fossiliferous. The base of the series is characterized by the occurrence in it of seams of anthracite and beds of clay ironstone. So far as examined, the eastward outcrop of these shales makes a rudely S-shaped curve, which extends from the N.W. of Moresby Island across Skidegate Channel (or Inlet) to Graham Island, and includes South, Maud and Lina Islands. This edge of the syncline has a general westerly dip of from 9° to 30°.

The western outcrop of the Lower Shales has been traced across the N.W. arm (called Long Arm on the map) of Skidegate Channel, from the S. to the N. side, to the Queen Charlotte Anthracite Coal Mining Company's works at Cowgitz. The strata here are much contorted, but have a general easterly dip at a high angle. With the exception of one species, all the fossil shells were obtained from rocks of this division, the two outcrops of which are indicated on the map by the figures 1, 1. *Unio Hubbardi* was found abundantly in bituminous shale at Wilkes tunnel, near Cowgitz (F.): and specimens of a bivalve, probably *Inoceramus concentricus* of Parkinson, were collected at a small bay to the south of Christie Bay (F.): all the rest are from either Maud or Lina Islands. As the shales on these two islands belong to the same geological horizon, Mr. Richardson did not think it necessary to keep the fossils from each locality apart, and it is now impossible to separate them.

2. Coarse Conglomerates.—The line of strike of these beds runs parallel to that of the rocks of the previous division. The shaded portions on the map indicate the distribution of the conglomerates as actually observed, and the dotted lines which enclose figure 2, show their supposed extension under water. No lines of bedding were traced in these deposits, which appear to be unfossiliferous.

3. Upper Shales and Sandstones.—The position of these rocks is in the centre of the syncline. Their outcrop has been followed along part of the north shore of Skidegate Channel, on Graham Island, which forms the northern boundary of the space partly surrounded by dotted lines on the map. These last inclose a solitary 3, as well as Reef Island and Weed Rock. A few fragments of fossil plants were collected in the Upper Shales at one locality (F.), also two or three specimens of a shell

which may be *Inoceramus concentricus*, but which are so fragmentary, or else so much distorted, that their generic position even is uncertain.

Besides plant remains, which are of frequent occurence, the collection contains fourteen species of Cephalopoda, six of Gasteropoda, twenty-two Lamellibranchiate bivalves, two Brachiopoda and a Zoantharian coral. It will be most convenient to describe these fossils first, and to discuss their probable geological horizon afterwards, but it may be briefly stated here that there is an apparent mixture of oolitic and cretaceous types. This circumstance has necessitated double comparisons throughout, and has added not a little to the difficulty of the undertaking.

The sculpture of the shells is generally well preserved, but in consequence of the laminated structure of the matrix, most of the specimens have been subjected to such a variety of distortion and compression, that it is impossible to tell what their original shape was. In addition to this, they are frequently imperfect or broken, and as in many cases there is but a solitary example of each kind, it may easily happen that what now seem to be specific characters, may prove to be only individual peculiarities when a more complete series has been obtained.

The most striking and characteristic fossils of the Lower Shales belong to the class Cephalopoda. Ammonites, in particular, abound almost to the exclusion of other genera, but none of them belong to divisions in which the shells are either simply or crenately keeled. Out of eleven species, eight have rounded backs, one belongs to Pictet's subsection Mammillati, while the two remaining, although ranked among the Clypeiformes, have the periphery obtuse. Another noticeable feature in the Cephalopoda from these shales is, that the commencement of the decline of the group, as a whole, through the half coiled types of the Ammonite family, is rarely perceptible. Such genera as *Scaphites*, *Hamites*, *Baculites*, *Helicoceras*, *Turrilites*, and *Toxoceras* are almost unrepresented. The only exception is a small fragment which is very doubtfully referred to *Hamites*, but which may just as likely have been part of an *Ancyloceras*.

In describing the Ammonites from these rocks, the most recent modifications of the divisions proposed by Von Buch and D'Orbigny have been adopted as far as practicable. At the same time it must be admitted that this system of classification is very unsatisfactory in practice. Many Ammonites present a mixture of characters, and such species might be referred to two, or even three, of these sections, with equal probability. Others, again, which have been placed in two separate groups,

and apparently with good reasons for so doing, have proved to be only different stages of growth of the same shell.

The old genus *Ammonites* of Bruguiere, with its eight or nine hundred of so called species, is a heterogeneous assemblage, which requires division into several genera and subgenera. Stoliczka says, very truly, that the animals of *Turritella* and *Cerithium* are not in any way more different than must have been those of *Ammonites discus* and *A. Rotomagensis*. The whole of the group has been revised anew, on the principle just indicated, by Dr. Waagen and others in Germany, and by Prof. A. Hyatt, in America. The new generic or subgeneric names proposed by these authors will be adopted in this memoir, at least in those cases in which there is a reasonable probability of their being correctly applied.

Considerable differences of opinion have existed, and probably always will exist, with regard to what constitute specific differences in these shells. Those whose experience has been gained by a study of many specimens in the field, naturally attach less importance to minute differences in form, surface markings and the like, than is accorded to them by others whose opportunities for extended comparisons have been few. In this connection the late Prof. Phillips justly remarks* :—"The zeal of collectors, by procuring them (Ammonites) of all ages and under different circumstances, has given occasion to coin too great a number of specific names. Yet for the most part, the diversity of names for a given set of forms indicates something really different in the history of the species, and most of the designations may be retained as marking varieties worth discrimination. In making, some years since, a strict comparison of the ammonites of the Yorkshire lias with others from the south of England esteemed to be of the same species, I found often some small differences, especially in the sutures, which might be best understood as local peculiarities of race. Ammonites to be really known as species, must be studied with many examples of every age, including the very young and the very old; the change of form in the course of life being often very great and remarkable."

In the present instance it has been impossible to comply with the conditions stated in the last sentence of the above quotation. Several of the species in this genus, for which new names will be proposed in these pages, are founded on a single imperfect specimen, and in no case has a large series been obtained. The same, indeed, may be said of all the shells in the collection. The septation, too, which, when properly studied, is

* "Geology of Oxford and the Valley of the Thames." Oxford: 1871. Page 131.

of great assistance in determining the specific relations of Ammonites, is rarely shown in these Queen Charlotte Island fossils.

The Gasteropoda obtained by Mr. Richardson are very few in number, and the specimens are almost always fragmentary or badly preserved.

Lamellibranchiate bivalves are abundant, both in species and individuals. The surface markings of these shells are often well shown, but the characters of the hinge teeth, and the impressions on the interior of the valves can rarely be ascertained. The family Hippuritidæ has no representatives; *Vola* and *Spondylus* are also absent, and there is only a single species of *Inoceramus*.

Brachiopoda are extremely scarce, only four broken and exfoliated specimens were collected, which belong apparently to two species.

The solitary coral is a compound Zoantharian, belonging to the family Astræidæ.

Out of forty-two species of Mollusca proper, three (*Ammonites Brewerii*, *A. Stoliczkanus* and *Aucella Piochii*) are well-known Californian fossils. *Aucella Piochii*, however, is probably identical with the *Aucella Mosquensis* of Europe. *Unio Hubbardi*, Gabb., is abundant at one locality in the Queen Charlotte Islands: it was originally described as from Vancouver Island, probably by mistake. It is the only fresh-water mollusk in the collection, and is, perhaps, the same as the *Unio aduncus* of Sowerby, from the Wealden deposits of England. Besides these, seven others are either very nearly related to European or Indian species, or are actually identical with them. The rest seem to be new to science, but the specimens are sometimes so imperfect, that it is not thought desirable to propose any specific names for them.

Without wishing to introduce any innovations in the use of terms, or to criticize the descriptions of others, it becomes necessary to define the sense in which certain expressions will be used here, as the same words have been employed to convey very different and even opposite meanings.

It has long been customary with palæontologists to call the outer edge of the shell of a Nautilus or Ammonite, the *dorsum*, and some still continue to do so. According to Prof. Hyatt, "the position of the female Argonaut in her shelly case, and of the Nautilus in its shell, show conclusively that the periphery of the whorls of an Ammonite is the abdominal side, as stated by Richard Owen and Pictet." For this reason, Mr. Hyatt and some other writers call the outer margin of such shells, the ventral, and the inner, the dorsal region. To prevent any misapprehension which might otherwise arise, the term *dorsum* will be purposely avoided. Such phrases, as the *outer edge* of the shell of a

Nautilus, or the *siphonal edge* of that of an Ammonite, can scarcely be misunderstood, while the word *periphery* will suit either indifferently.

The expression *aperture*, as applied to these fossils, is purposely chosen to describe the shape of the whorl at or near its outer termination, as viewed transversely; but not necessarily that of the true outer lip of the shell. The *height* of the aperture will be measured from the centre of the periphery of the outer whorl to that of the one which precedes it; the *width*, at a right angle to the height.

In describing the shells of Gasteropoda, the adjective *transverse*, when applied to ribs or striæ, is intended to mean transverse as to the whorls, and not as to the axis of the shell.

To preserve a certain consistency throughout, the *height* of lamellibranchiate bivalves will be measured, as nearly as possible, in the direction of a line drawn perpendicularly from the hinge line or dorsal margin, to the opposite or ventral border. The *length* will be estimated at a right angle to the height, and the *width* or *breadth* as equal to the maximum thickness through the closed valves.

As the valves of the Brachiopoda are respectively dorsal and ventral, the *length* of these shells will be measured from the beak of the pedicelled valve to its opposite extremity, while the *width* will correspond to the space between the two margins of either valve, at a right angle to the height.

Throughout these descriptions, the word *diameter* must be understood to imply the distance between two points, as measured on a flat surface.

Geographical names and others which, according to Dr. Johnston,* have a "reminiscential evocation," have been freely proposed for fossils which are believed to be new, especially in the case of genera, such as *Ammonites*, in which the number of species is already so large that it is almost hopeless to expect to find descriptive names which are not preoccupied.

In conclusion, the writer desires to express his cordial thanks to Mr. W. H. Dall, of Washington, who has kindly made and forwarded tracings of figures as well as copies of descriptions of certain fossils from books not at present accessible in Montreal, and for various critical suggestions; to Mr. F. B. Meek, also of Washington, who obligingly sent photographs of drawings made from the original types of species from Vancouver and Sucia Islands, described by him; to Mr. Richardson for information as to the exact stratigraphical position and localities of the fossils which he collected; and to Mr. A. H. Foord, for the pains he has taken in the delineation of the features characteristic of the different species.

* "British Zoophytes." Second Edition. Vol. I., page 164.

DESCRIPTIONS OF SPECIES.

CEPHALOPODA.

Belemnites. (Sp. undt.)

Plate I., figs. 1*a*,, 1*b*. and 1*c*.

Fig. 1.

Fig. 1.—*Belemnites, species.* Outlines of a longitudinal section of the best specimen collected. The position of the apical groove is seen at *a*, and indications of what is supposed to have been the siphuncle, may be traced at *b*. The restoration of the point is purely hypothetical.

Three more or less fragmentary specimens of a Belemnite of medium size, which collectively show many of the characters of the guard and phragmocone. As each of these exhibits some peculiarities which are not seen in either of the others, it will be best to describe them separately.

No. 1 is a portion near the anterior (or thickest) end of the guard, about an inch and a half in length, and partly imbedded in shale. The specimen is broken transversely below and obliquely above, so as to give two natural sections at different angles. The outline of the transverse section is ovately orbicular, the sides being distinctly compressed. The lateral diameter is nearly one-sixth less than the dorso-ventral; the measurements being about five and a half by six and a half lines. The

tangential section shows only that the septa of the phragmocone are rather more than a line apart at the widest end.

No. 2 is also a fragment near the anterior end of the guard, but it is entirely free from any investing rock. As viewed transversely, its outline is more nearly circular than that of No. 1, and its sides are less distinctly compressed. The measurements in this instance are seven by scarcely six and a half lines across. The phragmocone (Plate I., fig. 1*a*) which is loose in this specimen, is elongately but inversely conical and inequilateral, with the apex distinctly eccentric. Its length is about thirteen lines; its greatest width nearly six lines, and its least, less than one. At its widest end it is ovate-orbicular in section, as is also the alveolar cavity; the presumed bulbous termination is broken off. Judging by faint lines on the cast, the septa appear to be slightly oblique and very numerous; they are about a line apart at the widest end, and at least four times as close together at or near the point.

No. 3 (Plate I., fig. 1) is the most perfect example yet procured, and like the first, is entirely free from the matrix. Its length is an inch and three-quarters, its greatest width seven lines, and its least, scarcely six. The anterior extremity of the guard contains more than two-thirds of the alveolar cavity, (as compared with No. 2) and at the opposite end wants only the extreme apex. In this specimen the sides of the guard are more decidedly compressed than they are in either Nos. 1 or 2. The guard itself is sub-cylindrical, and does not decrease in size perceptibly, until about an inch from the tip, when it begins to narrow unequally and rather suddenly. The apex being broken off, it is impossible to tell whether the tip was obtusely pointed or shortly acuminate, but the contour of the remaining part shows that it was slightly eccentric. At or near the tip there is a faint and inconspicuous groove, which probably measured about seven lines, if we allow two or three for the piece broken off. The compression of the guard is a little oblique, so that the outline of a transverse section at the anterior end is elliptic ovate, one end being a little wider than the other. The apical groove is placed, not on either of the flattened sides, but in a direction corresponding to that of the widest end of the ovoid.

A longitudinal section of this specimen, kindly made by Mr. Weston, of which Fig. 1 is a representation, revealed some additional particulars. The entire length of the guard is twenty-one lines, and of this the phragmocone occupies ten lines. The apex of the phragmocone is slightly eccentric, and seems to point in the same direction as does that of the guard. Traces of what is supposed to be the siphuncle were detected

crossing some of the upper septa of the phragmocone, and it would appear that the siphuncle is placed on the same side as that towards which the apices of the guard and phragmocone point.

Mr. S. P. Woodward says* that the apex of the phragmocone of a Belemnite points to the ventral side of the guard, and if this be uniformly the case, then, in this species both the siphuncle and the apical groove are probably ventral. M. Duval Jouve,† however, maintains that in some of the Neocomian Belemnites the siphuncle is dorsal, and in others ventral. Hence it is by no means certain that the apical groove, or the siphuncle of this species, are ventral, but both seem to be situated on the same side, and that the one towards which the apices of the guard and phragmocone point.

In his remarks upon the Queen Charlotte Island Cephalopoda already referred to, Mr. Billings says that these small Belemnites belong to the sub-section Acuarii of Bronn's section Acæli, also that they are "closely allied" to the *Belemnites Russiensis* and *B. Kirghisensis* of D'Orbigny, two species which are described and figured in Volume II. of Murchison Verneuil and De Keyserling's "*Geologie de la Russie et des Montagnes de l'Oural.*" In both of these opinions the writer entirely concurs, but the Belemnites collected by Mr. Richardson are apparently distinct from both of their Russian analogues. The guard of *B. Kirghisensis* is represented as much longer and slenderer than is that of the present species, and in *B. Kirghisensis* the apices of the guard and phragmocone point in opposite directions. The general shape of the guard of *B. Russiensis* is certainly very like that of the fossil now under consideration; but in the Russian Belemnite the apical groove is placed on one of the flattened sides, which, moreover, appear to be respectively dorsal and ventral.

No traces of a slit down the anterior end of the guard could be detected, nor any indications of a corresponding raised rib on the phragmocone, so that these specimens can scarcely be referred to D'Orbigny's genus Belemnitella, but to Belemnites proper.

The specific characters of these Belemnites are so imperfectly shown in the few fragments yet obtained, that it is not thought desirable to propose a new name for them, although they cannot be satisfactorily referred to any known species, and are probably new to science. The peculiar compression of the guard may be due to the distortion to which so many of these fossils have been subjected.

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* "Manual of the Mollusca." Page 73.

† "Monograph of the British Belemnitidæ." By Prof. Phillips. Part II., page 30. Palæontographical Society: 1866.

Belemnites. (Sp. undt.)

Besides the three specimens described above, a tolerably complete phragmocone and a portion of another were collected, which must have belonged to Belemnites of considerable size. Mr. Billings describes the most perfect of the two as follows:—"It consists of a portion of a large phragmocone, two and a half inches in length, one and a half inches across the larger extremity, and thirteen lines across the smaller. The septa are moderately convex, and there are twelve chambers in the specimen." Little can be added to this description; the measurements have been tested and found essentially correct, though the diameter of the smaller end seems nearer to twelve than to thirteen lines. These fragments may indicate the existence of a second species at this locality, or they may represent merely the adult stage of the one first described. The evidence is altogether insufficient to show which of these views is the correct one, though the latter is, perhaps, the most probable supposition.

Nautilus. (Sp. undt.)

Perhaps N. elegans, D'Orbigny,* but not of Sowerby.

Or, possibly, N. pseudo-elegans, D'Orbigny.†

Shell (or rather cast) inflated, globose; maximum thickness not much less than the entire diameter, the proportions being nearly as five to seven; umbilicus either very small or entirely closed, most probably the latter. Most of the inner septa are crushed out of shape, but the outline of the outer one is concave and simple; the position of the siphuncle is unknown. Aperture transversely reniform or sublunate, rather deeply emarginate by the preceding volution. Measuring from the periphery to the centre of the margin of the next whorl, where the emargination is greatest, the height of the aperture is much less than its width. The surface of the cast is ornamented with transverse radiating ribs, which at first curve convexly forwards across the sides, and then backwards, so that each one forms a shallow, but rather angular sinus on the periphery. The ribs appear to run exactly parallel with the true outer lip of the shell, and their forward curve is

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* "Paléontologie Française. Terrains Crétacés." Vol. I., page 87. Atlas, Plate XIX.

† " " " " Vol. I., page 70. Atlas, Plates VIII. and IX.

greatest near the aperture. They are narrowest at the umbilicus, and widen gradually towards the periphery, where they measure about two lines in width.

Greatest diameter, about seven inches; approximate width of aperture, (which coincides with the maximum thickness at a right angle to the diameter) slightly over five inches; height of aperture, in the centre, three inches and seven lines. The specimen being very much distorted, these measurements must be received with caution.

One of the most striking specimens in Mr. Richardson's collection is the large Nautilus described above. Unfortunately this unique example is badly preserved, and very much crushed out of shape. The siphuncle is not visible anywhere, although the fossil happens to be broken in two pieces, in such a way as to expose most of the interior. The distortion is greatest in the chambered part of the shell, so that it is impossible to tell how many septa there were to a volution, or to define their exact shape.

The species is very nearly related to the *Nautilus elegans* of D'Orbigny, and to the *N. pseudo-elegans* of the same author; but it may prove to be distinct from both.

It is clear that the Queen Charlotte Island fossil is not the *Nautilus elegans* of Sowerby, for in that shell the aperture is said to be "obtusely sagittate, with the posterior angles truncate." The description and figures in the "Mineral Conchology" give one the idea of an obliquely compressed shell, with an aperture whose height is much greater than its width. Before the writer was aware that Pictet had shown that the *Nautilus elegans* of D'Orbigny and Sharpe is distinct from the *N. elegans* of Sowerby, the same conclusion had been arrived at after a careful study of the original diagnoses. D'Orbigny describes his *N. elegans* and *N. pseudo-elegans* as follows, Italics being substituted for Roman letters to emphasize certain points:—

Nautilus elegans, D'Orbigny (as of Sowerby).

"N. testâ *globulosâ inflatâ*, transversim sulcatâ; sulcis incurvis, reflexis, umbilico impresso, *non perforato*; aperturâ latâ, semilunari; septis simplicibus, arcuatis; siphunculo ad tertiam exteriorem septorum partem perforato."

Nautilus pseudo-elegans, D'Orbigny.

N. testâ *discoideâ*, *inflatâ*; transversim undulato-sulcatâ, *subumbilicatâ*; aperturâ semilunari; septis arcuatis, in umbilico sinuosis; siphunculo non centrali ad inferiorum limbem septorum adplicato."

The following remarks are added to the description of *N. pseudo-elegans*:—" rien de plus facile que de la confondre extérieurement avec le *Nautilus elegans* de Sowerby. En effet les deux espèces sont lisses dans le jeune âge, et sillonnées à peu près de la même manière dans l'âge adulte: mais elles sont néanmoins entièrement différentes. Le *Nautilus pseudo-elegans* se distingue du *Nautilus elegans par son dos plus large*, et surtout par ce caractère invariable, que la siphon est placé au tiers intérieur de la hauteur de la bouche, près du retour de la spire, au lieu de l'être au tiers exterieur ou près du dos, comme il l'est toujours dans le *Nautilus elegans*."

As the position of the siphuncle is unknown in the specimen from the Queen Charlotte Islands, the question naturally arises, is it possible to distinguish *N. elegans* (D'Orb.), *N. pseudo-elegans*, and closely related species, by any other characters? Judging by the descriptions in Latin, *N. elegans* would seem to be a thicker and more ventricose shell than *N. pseudo-elegans*, but the italicised remarks in French, and the figures in the "Paléontologie Française" convey just the opposite impression. Sharpe states that *N. elegans* (D'Orb.) "is the most globose shell of the group, and has the smallest umbilicus." His figure (Cephalopoda of the Chalk Formation, Plate III., fig. 3) is almost an exact portrait of the specimen obtained by Mr. Richardson, and the dimensions which Sharpe gives of his fossil ("diameter six and a half inches, breadth five inches,") accord remarkably well with those of the present shell. These statements, as well as the impressions conveyed by the figures, are, however, negatived by the remark that "the two species are so much alike, that the *only* character to be relied on for distinguishing them is the position of the siphuncle." It follows that the exact specific relations of the Queen Charlotte Island fosssil cannot be ascertained until more perfect examples have been obtained. Blanford says that there are fourteen septa to the whorl in *N. elegans*, (D'Orb.) and that in *N. pseudo-elegans* there are twenty in the same space. In the Queen Charlotte Island specimen it is impossible to ascertain whether the septa were originally distant or approximating.

Pictet and Blanford have shown that the position of the siphuncle in certain European and Indian cretaceous Nautili is not invariable in the same species. Some Nautili, also, which agree in the position of the siphuncle, differ materially from each other in external form. For these reasons there is a tendency among palæontologists to regard *N. elegans* (D'Orb.) and *N. pseudo-elegans* as varieties of one species. Still, most authorities have pronounced themselves in favour of their distinctness,

among whom may be mentioned Pictet, Cornuel and Blanford; as well as D'Orbigny and Sharpe. Should the latter view be adopted, the laws of nomenclature require (as Blanford has pointed out) that D'Orbigny's name should be changed, as it is preoccupied. It might have been a fitting compliment to the Swiss naturalist who first called attention to its distinctive features, to have dedicated the species to him, but Oppel has already called a Nautilus from the Upper Tithonic beds at Stramberg, *N. Picteti*. This being the case, the name *N. Atlas* is proposed as a substitute for that of *N. elegans*, D'Orbigny. The Queen Charlotte Island specimen may or may not belong to the same species.

A Nautilus collected by Mr. Richardson, in 1874, from the Cretaceous rocks of Sucia Island, which is in an excellent state of preservation, (although a little distorted) bears a striking resemblance in many respects to the type of *N. Atlas*. It is a much less globose shell than the Q. C. Island specimen; its umbilicus is entirely closed, and the siphuncle is situated a little on the outside of the centre of the septa. Eight septa are visible externally in the space of rather more than half a whorl; the ribs on the inner, or nacreous layer of the test, are proportionately broader than are those of the Q. C. Island shell, and they each form a wide but not angular sinus on the periphery. There is a distinct though not very large excavation round the umbilical callus. Near the aperture, the height of the whorl, outside of the emargination caused by the encroachment of the preceding volution, is not much less than its breadth. The dimensions are about as follows, but no allowances have been made for obvious distortion :—

Greatest diameter, four inches and one line; width of aperture (which is identical with the maximum of thickness) two inches and five lines; height of do., in the centre, eighteen lines.

This fossil will be described more at length in another place, but its prominent characteristics are given in advance for the sake of comparison. The siphuncle of this shell seems to be placed rather nearer to the centre of the whorl than is the case with *N. Atlas*. The Sucia Island fossil is very nearly related to *N. Atlas*, of which it is probably only a variety; the Q. C. Island specimen, on the other hand, may prove to be nearer to *N. pseudo-elegans*.

The few Nautili of the section Radiati, which have yet been described or quoted as occurring in the Cretaceous rocks of the United States, present curiously close affinities with European species. The apparent specific relations of the former may be thus briefly expressed, though

an examination of the type specimens would be necessary for a satisfactory comparison. The group, as a whole, may be conveniently arranged as follows:—

A. Umbilicus small, or entirely closed.

B. Umbilicus comparatively large.

1852. "Nautilus elegans, Sowerby."

Rœmer's "Kreidebildungen Von Texas," page 37, No. 37.

No description or figure of this shell is given, and all that is stated is that "some imperfect specimens from the waterfall of the Guadaloupe, below New Brauenfels, plainly show the peculiar, undulating, arched ribs on the surface, characteristic of this species."

1860. Nautilus Texanus, Shumard.

Transactions of the Academy of Sciences of St. Louis. Vol. I., page 190.

As the specimens from which this species was described are mere fragments, which do not show the characters of the umbilicus, it is not certain to which of the divisions proposed above it should be referred.

The shape of the aperture of *N. Texanus* is not unlike that of *N. elegans*, (Sow.) but the position of the siphuncle is the same as in *N. pseudo-elegans*, the species with which Dr. Shumard compared it.

1862. "Nautilus elegans, Sow., var. Nebrascensis," Meek.

Proceedings of the Academy of Sciences of Philadelphia for 1862, page 25.

In the paper where this Nautilus is described, Mr. Meek, naturally enough, seems to have taken the correctness of D'Orbigny's and Sharpe's identifications for granted, without further inquiry. The description of the Nebraska fossil, at least, accords much better with that of *N. Atlas* (nobis) than with Sowerby's diagnosis of his *N. elegans*. The globose shape, together with the position of the siphuncle in the American shell, are in favour of this view, but it is possible that the varietal name, proposed by Mr. Meek, may have to be raised to specific rank, as the sculpture of the so-called "variety *Nebrascensis*" is said to consist of ribs which are "five times as broad as the grooves between," and in this respect it differs from *N. Atlas*, as well as from nearly related species.

1864. Nautilus Texanus (?) "Shumard." (Gabb.)

"Palæontology of California." Vol. I., page 59] Plate IX., figures 3*a. b.*

There are some reasons for doubting whether the Californian shell, described and figured in the work quoted above, is correctly referred to Dr. Shumard's species. The siphuncle appears to be placed differently in the two shells; in *N. Texanus* (Gabb.), it is said to be situated above the centre of the whorls, as is the case in *N. Atlas*; in *N. Texanus*, (Shumard) its position is described as below the centre of the volutions, as in *N. pseudo-elegans.*

It is most likely that *N. Nebrascensis*, Meek, *N. Texanus*, Gabb (non Shumard), and the Sucia Island *Nautilus* are all forms of one variable species.

The discovery of such forms as *Nautilus spirolobus*, Dittmar, in the "Hallstadten Kalken" (or Trias) of Rossmoos, near the Lake of Hallstadt, of *N. Mojsisovicsi*, Neumayr, in the Middle Oolite of Poland, and of the *N. Asper*, Zittel, a species closely allied to the present fossil, in the Upper Tithonic beds of Moravia, has recently proved that the ribbed Nautili are by no means exclusively confined to the Cretaceous rocks, as was formerly supposed. Still, they are eminently characteristic of the Chalk Formation, in which they attained their maximum of development as a group.

AMMONITES.

Group I.—Clypeiformes, D'Orbigny.*

Sub-genus Oppelia, Waagen.—"Geognostisch-Palæontologische Beitrage." Von Dr. E. W. Benecke. Page 250. Munchen: 1869.

Ammonites Perezianus. (N. Sp.)

Plate II., figs. 1 and 1*a.*

(Perhaps a variety of Oppelia Waageni, Zittel. See "Die Fauna der Aelteren Cephalopoden Fuehrenden Tithonbildungen," by Dr. Karl Alfred Zittel. Cassel: 1870] Plate XXIX., figs. 1*a.* and 1*b.*)

Shell discoidal, lenticular, thin; umbilicus small; surface ornamented by broad, faint and transverse folds.

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* The numbers attached to these groups refer only to the present collection. The order is nearly that adopted in the "Palæontologia Indica," but the Ligati are placed between the Planulati and Fimbriati, instead of before the Planulati. In the case of the Ammonites only, a short definition of the salient characters of each species is prefixed to the more detailed description.

All the inner volutions are covered by the last whorl, excepting only their umbilical faces. Outer whorl nearly flat, or only slightly convex at the sides; periphery narrowly rounded and obtuse; inner edges of the volution oblique, almost confluent with the sides, the point of junction being marked by a faint, rounded shoulder. Aperture narrowly elliptical, deeply emarginate by the preceding volution. The height of the aperture, as measured where the emargination is deepest, is more than twice its width. Umbilicus small, shallowly funnel shaped, rather deeply conical in the centre, but spreading rapidly and obliquely in the outer whorl, especially near the mouth. Umbilical margin almost obsolete, sutures (of the volutions) indistinct, not excavated or channelled.

Surface marked by very faint and inconspicuous, transversely radiating plications. These are undulating, broad and rounded, but not much raised, and are about equal in width to the shallowly concave depressions which separate them. The folds are most prominent on the outer half of the sides; they seem to be obsolete on the periphery and are certainly so on the inner faces of the whorls.

The adult and unique specimen figured on Plate II. is much water-worn on the only side in which the septation is visible, and the finer ramifications of the sutures have been obliterated. There are indications of six or seven lobes in the septum nearest the mouth, and of these the four or five inner ones appear to have been simply toothed but not branched. Those placed near the periphery do not seem to have been very complicated in their structure. The "chamber of habitation" occupies nearly three-fourths of the outer whorl.

Greatest diameter, three inches and nine lines: width of umbilicus, as measured from the junction of the sides with the inner surface of the body whorl, nine lines; or, from suture to suture, five lines. Height of aperture, at the point where the emargination is greatest, one inch and nine lines: greatest width of do., ten lines. Depth of emargination of the outer whorl, eleven lines.

When the drawings were made, nearly the whole of one side of the fossil was covered by a nodule of shale. After the plates which contain figures of this species were printed, the matrix was removed from the specimen, and some new information was thus obtained which has been incorporated into the above description. The outline of the aperture (figure 1a) was found to be incorrect in two particulars. First, the emargination is not nearly deep enough, and secondly, the periphery,

(which happens to be water-worn in the original) is represented as too narrow and acute.

Ammonites Perezianus is nearly related to *A.* (*Oppelia*) *subcostaria* * Oppel, and particularly to *A.* (*Oppelia*) *Waageni* of Zittel. The former is represented as having a more rectangular umbilicus than *A. Perezianus* as well as fewer and more distant folds on the sides of the outer whorl. Both have thicker shells than the species just described, and *A. Waageni* is depicted as having an entirely smooth surface. On the other hand, the only specimen of *A. Perezianus* yet procured is a little crushed, and there is reason to suppose that its whorls were thickest near their middle, so that the shape of the shell was nearly, if not quite, lenticular in its normal state. Even supposing this to have been the case, *A. Perezianus* is a thinner and flatter shell than *A. Waageni*, and the difference between the sculpture of the two may be of specific importance. Under all the circumstances, it seems desirable to propose a provisional name for the species, and the one suggested is intended to help to perpetuate the memory of the first discoverer of the islands at which the fossil was collected.

Ammonites Brewerii Gabb.

Plate 1, figures 2, 2*a*, and 3, 3*a*.

Ammonites Brewerii Gabb.—"Palæontology of California," Vol. I., page 62, Plate X., fig. 7. Also Vol. II., page 130, Plate XX., fig. 5.

The Ammonites from the Queen Charlotte Islands which are believed to belong to this species, present two strongly marked varieties. The specimen represented at fig. 2 † is the largest individual of what may be fairly regarded as the typical form, as it corresponds exactly with Mr. Gabb's amended description of his *A. Brewerii*, although the original figures of the adult have a strongly ribbed surface, whereas that of normal examples collected by Mr. Richardson is either smooth, or ornamented only by faint, sinuous, transverse striæ. Figure 3, on Plate I., is a portrait of the most perfect of two specimens of what seem to be a dwarfed variety of this shell, presenting characters, (such as a comparatively large umbilicus, strong rib-like folds, &c.) which are usually only seen in much larger individuals. It will be convenient to consider each form separately, and as the only work in which *A. Brewerii* was described

* "Geognostich-Palæontologische Beitrage." Von Dr. E. W. Benecke. Zweiter Band. Heft 2, page 219 Plate XIX., figs. 2-5.

† On Plate I.

may not be accessible to some of the readers of these pages, the salient features of both will be briefly particularized.

General characters.—Shell discoidal, compressed, periphery narrowly rounded; umbilicus rather small, step-shaped and rectangular: surface marked either by flexuous, transverse striæ, or by rib-like folds.

1. *Presumed typical form.*—Shell discoidal, compressed, but not very thin, the maximum width of the outer whorl being only one third less than its height. Volutions four, the inner ones flat, smooth and nearly two-thirds covered by those which succeed them. Outer whorl with somewhat flattened but slightly convex sides, the greatest thickness being a little below the middle; periphery rounded: inner edge of the volution cut squarely at a right angle to the sides; umbilicus step-shaped, rather less than one-fourth of the entire diameter; aperture elliptical or narrowly oval, truncate below, higher than wide, deeply emarginate by the preceding volution.

Surface ornamented by faint, flexuous, and slightly raised, transversely radiating striæ, which are usually arranged in two sets. What may be conveniently called the primary striæ start from the umbilical margin, and pass completely over the sides, but become indistinct or obsolete on the periphery. Commencing at the umbilicus, their general direction is first a little forwards, then backwards, and again forwards, until at last they form moderately convex but very faint arches over the periphery. Near their junction with the umbilicus they are often seen to be made up of two or even three separate raised lines, which coalesce about the middle of the sides, between which point and the periphery they always become most prominent, fold-like and distant. The secondary striæ, which usually alternate with the primaries, radiate from the umbilicus, but extend only half way across the sides. There is generally a single secondary striation between each pair of primaries, but there are sometimes two, and at others none at all. Besides these markings, there are numerous faint and short striæ on the periphery, but these disappear before reaching the sides. The striæ on the siphonal edge are much finer even than the secondaries, and seem to be distinct from them.

Greatest diameter of the shell, four inches and two lines: width of umbilicus about one inch. Width of aperture (which is identical with the maximum of thickness) nearly fifteen lines: height of do., outside of the emargination caused by the preceding whorl, twenty-three lines: depth of the emargination, six and-a-half lines.

The above description and measurements refer exclusively to the largest

specimen collected. Six others were obtained; one a very immature individual, about an inch and a quarter in diameter; and five of an intermediate and almost uniform size, which measure from two to two and a half inches across. The smallest shell is entirely smooth; the medium sized ones are only faintly striated across the whorls. These latter differ from the specimen figured, in the following respects: they are much thinner and flatter proportionately, their periphery is narrower, and their umbilicus is smaller as well as shallower. Such half-grown shells resemble the *Ammonites Haydenii* of Gabb very closely, but their periphery is not "nearly flat" and somewhat squared, as it is in that species, but narrowly and evenly rounded. Externally there are very few characters by which they may be distinguished, but the septation is said to be different in Californian examples of the two species. The septa are not visible in any of Mr. Richardson's specimens.

2. *Dwarfed costate variety.*—Figs. 3 and 3*a* on Plate I. represent the most perfect specimen obtained of this form, the other being a mere fragment. Its greatest diameter is two inches and five lines: the width of its umbilicus, eight or nine lines: the maximum thickness, seven lines. The fossil is, however, considerably distorted. It differs from the more typical form less in shape than in sculpture. The latter consists of simple, transverse and flexuous, rib-like folds, which are most prominent on the outer half of the sides. They form distinct, narrowly rounded, convex arches over the periphery and are faintest near the umbilicus. The elevations are usually narrower than the shallowly concave grooves which separate them. Sometimes a short rib occurs between two of the ordinary ones, but when this is the case it generally forms a short arch over the periphery and does not reach to the umbilicus. The folds also show a tendency to bifurcate over the periphery, and there are some other unimportant and exceptional variations. The greatest thickness of the whorls in this variety is a little above the middle of the sides.

Ammonites Brewerii was first described from the "Shasta Group" of Cottonwood Creek, Shasta County, California, where it appears to be tolerably abundant. Until Mr. Richardson collected the specimens described above from the Islands in Skidegate Channel, the species had not been obtained from any other locality.

Ammonites difficilis of D'Orbigny, a French Neocomian fossil, is its nearest European representative. Both *A. difficilis* and *A. Brewerii* are very abnormal representatives of the Clypeiformes, but as D'Orbigny and

Pictet place *A. difficilis* in this section, *A. Brewerii* is included in it also. The latter palæontologist says that *A. difficilis* "makes a transition" to the Ligati.

Group II.—Mammillati, Pictet.

AMMONITES STOLICZKANUS, GABB.—Variety spiniferus.

Plate III., fig. 3, and Plate IV., fig. 1.

A. Stoliczkanus, Gabb. "Palæontology of California." Vol. II., page 135. Plate XXIII., figs. 16, 16*a*.

FIG. 2.

FIG. 2.—Ammonites Stoliczkanus, Gabb., var. spiniferus. Fragment showing the spinous nature of the tubercles.

Shell thick; whorls wider than high, compressed on the siphonal edge and inner half of the sides; umbilicus not very large, but deep; surface heavily costate; ribs tuberculate, except on the centre of the periphery.

Whorls five, increasing rather rapidly in size, about one-half of the inner ones being exposed. The volutions are always broader than high; in a well-preserved specimen an inch in diameter, they are distinctly

though obtusely bicarinate on the periphery, and obsoletely keeled at the sides. With the increase of growth the keels disappear, and the whorls become more rounded, until finally the last one assumes a subquadrangular aspect. The inner half of the sides of the body whorl is compressed, the outer half curves convexly and rather obliquely towards the periphery, which is broad and flattened. The umbilical face of this volution is squarely as well as very deeply truncate, and forms a blunted but nearly right angle with the sides. In the last whorl but one, the umbilical face is not straight, but slightly convex, and the angle between it and the sides is rounded off. All the specimens are so much distorted that it is difficult to estimate the proportionate width of the umbilicus with much accuracy, but in the example represented on Plate III., which is not fully grown, it is about one-third of the greatest diameter. In the adult the last whorl increases very much in height, so that the umbilicus may then be rather smaller in proportion to the shell. The aperture is transversely subquadrangular, the outer angles being broadly rounded; its height is rather less than its breadth, and the emargination of the base is not very deep.

The sculpture consists of broad, but not acute, raised ribs, and these are ornamented with tubercles, some of which originally bore long spines. In the inner whorls the ribs are straight, but in the last volution they are slightly flexuous. In the specimen previously referred to as being about an inch in diameter, the sculpture of the early whorls is well exhibited. At the commencement of the outer volution of this individual, each rib bears four tubercles, but when it is completed there are eight to each rib; the process of a gradual division of each tubercle into two separate ones being very clearly shown. At this stage of growth the tubercles are prominent, acute, and are separated into two sets by a shallowly-grooved space on the periphery. In the penultimate whorl the number of tubercles on each rib is generally twelve, or six on each side, and there are never more than these. They are usually situated at unequal distances from each other, and are separated by a flattened but not grooved space on the periphery.

It is only just to the artist to say that the spinous nature of some of the tubercles was discovered after the plates which contain figures of this species were printed. While attempting (subsequently) to remove the matrix from a broken example, a fortunate blow of the hammer exposed three long spines, two of which are very perfect. This specimen, which is represented in the woodcut (fig. 2), is a fragment, consisting of about two-thirds of the penultimate whorl, and a portion of the preceding

one. In this instance each spine arises from the inner margin of the smaller whorl; they are at first pressed a little downwards, and then curve upwards so as to rest against the umbilical wall, though they scarcely reach to its margin above. One of the spines is fully half an inch in length; it is flattened and rather obtusely pointed. The compression of the spines and their peculiar curvature are obviously the result of abnormal compression or distortion. Traces of spines were afterwards observed in other specimens, but all the additional information afforded is that they sometimes proceed from the outer as well as the inner parts of the sides, that they are occasionally acuminate, with a dilated base and slender point, also that they are often covered up by the whorls as the shell increases in age. In every place where they were traced, they were found to be protected from injury by the support afforded by the inner margin of the whorl next to the one on which they were placed.

Most of the tubercles become obsolete or disappear on the body whorl, excepting only a row of large ones round each umbilical margin, and another of much smaller size, placed about the middle of the sides. The ribs on this volution are alternately bifurcating and simple, but they are all of equal length, and bear usually a similar, or rather corresponding number of tubercles. The row of large tubercles round the umbilical margin gives to that opening a distinctly coronated aspect, but those on the middle of the sides are sometimes so small as to be barely perceptible. The aperture of the original of fig. 1, on Plate IV., is about three inches and three-fourths wide, by three inches and one line in height.

Seven specimens of this "strongly characterized" species were obtained, most of which are curiously distorted. None of them are very perfect, and yet nearly all of the essential peculiarities of the fossil are well exhibited in one or the other, except the outlines of the septa and the shape of the outer lip.

In the preliminary report previously referred to, Mr. Billings says that the specimens just described are nearly related to *Ammonites Stoliczkanus*, but that they are "perfectly distinct" from it. The difference between the shells from the two localities seems to the writer to be scarcely of specific importance. *A. Stoliczkanus* was originally described from a single half grown example, about three inches and three quarters in diameter. Apart from the circumstance that some of the tubercles originally bore long spines, (a feature seen so rarely even now that there is no wonder that it was not observed before) Mr. Gabb's description of the

Californian shell applies with great exactness to the present specimens, except in one particular. Each rib in the type of *A. Stoliczkanus* is described as bearing six tubercles, three on each side of the periphery, but there are usually nearly double that number in the corresponding costæ of the fossils collected by Mr. Richardson. Although this might appear to be an important difference, it is doubtful whether it is of more than varietal value. The number of tubercles to each rib is variable in actual specimens, and they show a marked tendency to divide into two or three in the course of growth. Thus, in the last whorl but one of the original of Plate IV., fig. 1, there is a single tubercle on the umbilical margin, another on the middle of the sides, and a third trifid one on the edge of the periphery. The description of the tuberculation of the type agrees so well with some of the Queen Charlotte Island specimens, that the latter are, (for the present at least) regarded as simply a variety of *A. Stoliczkanus* with rather more numerous tubercles than usual, to each rib.

Pictet's group Mammillati, in which this species is placed, differs from the Rotomagenses chiefly in the absence of tubercles or carination on the periphery of the shell. It is partly made up of Ammonites taken from that division and from the Dentati. *A. laticlavius* of Sharpe, from the Grey Chalk of the Isle of Wight, bears a considerable resemblance to this shell, but the whorls of the English fossil are flatter, and its aperture is much higher than wide.

Group III.—Macrocephali, Von Buch.

Subgenus Stephanocéras, Waagen (Pars.)—"Geognostich Palæontólogische Beitrage," von Dr. E. W. Benecke, Munchen, 1869. Vol. II., page 248.

Ammonites Loganianus. (N. Sp.)

Type. Plate VIII., fig 2.

Shell compressed, but rather thick; inner whorls entirely covered, except about three-fourths of the last one;* umbilicus of medium size.

The early volutions are apparently very strongly involute, but the two outer ones are much more loosely coiled. The last whorl is obliquely compressed at the sides, which are widest just before they

* In the only two specimens obtained, the centre was covered by the matrix and it is just possible that if this were removed, rather more than one volution and three-fourths of another would be visible externally. Still, the shale was detached from the umbilicus of the example figured, to a depth of nearly three-quarters of an inch, without a trace of the inner whorls being exposed.

commence to descend towards the sutures; the periphery is rounded but slightly flattened. The aperture is subovate, its base being con-

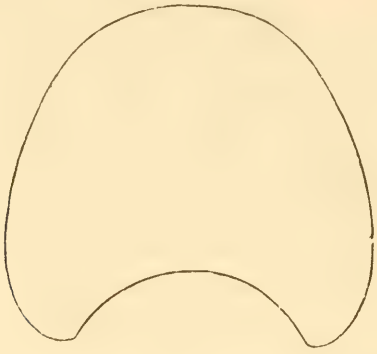

Fig. 3.

Fig. 3.—A. Loganianus, outline of the aperture of a typical specimen.

cavely emarginate. If measured in the centre, where the emargination is greatest, the height of the aperture is rather less than its width, but as viewed externally the height and width of the whorls are nearly equal.

The umbilicus of the most perfect specimen is rather less than one-third of the entire diameter; its inner face is somewhat straight and precipitous below; its outer margin is evenly rounded. It is deeply excavated in the centre of the shell, but becomes shallower very rapidly towards the mouth.

The surface ornamentation consists of primary, trifurcating ribs, which usually alternate with secondary, simple and shorter ones. Commencing at the sutures, the primaries are at first distant, obtuse and prominent; then at about a third of the distance across the sides, they trifurcate and pass over the periphery, reuniting at exactly similar points. The points where the primaries begin to trifurcate are marked by small elevations, or tubercles.* The intervening costæ are simple and do not extend to the sutures, but become obsolete near the middle of the sides. Sometimes the secondary ribs are absent, and there is rarely more than one between each pair of primaries. Although much worn in the actual specimens, there is reason to suppose that all the costæ were originally acute; the grooves between them are concave, and a little wider than the

* In one specimen, these are narrow and elongated; in the other, whose surface is much abraded, they are rounded and obtuse; in both they are feebly marked and inconspicuous.

ribs. As viewed along the siphonal edge, the whole of the costation is rather fine in proportion to the size of the shell; near the aperture, the greatest distance between the summits of two contiguous ribs (on the periphery) rarely amounts to as much as two lines, the average being about a line and a-quarter.

The specimen figured, which although in some respects the most perfect of the two, is very much distorted, measures about five inches in its greatest diameter, the width of its umbilicus being about eighteen lines. The other is four inches and two lines across, and its umbilical cavity is fifteen lines wide.

A. Loganianus (?) Form A.

Plate IV., figs. 2, 2*a*.

Shell subglobose; inner whorls entirely covered except the outer half of the last one; umbilicus rather small.

Outer whorl somewhat inflated, broadly rounded on the periphery, and slightly compressed at the sides. Umbilical cavity rather more than one-fourth of the entire diameter, deep in the centre and shallow exteriorly. Margin of the umbilicus rounded, its inner face steep but low. Behind the mouth of the shell there is a broad and moderately deep groove or constriction, and the whorl contracts very perceptibly at a short distance from the aperture. Near the sutures there is a shallow sinus on each side of the lip, which is produced into a broadly rounded process on the periphery. The groove behind the mouth seems to follow the contour of the outer lip, unless the latter once bore lateral lobes, of which there is no evidence. The aperture is transversely arcuate, its breadth being nearly three times as great as its height. In the middle of the same whorl, before it begins to narrow, the height of the volution is much greater in proportion to the width.

The sculpture consists for the most part of primary ribs, which rise from the sutures, and bifurcate at about a third of the distance across the sides, before passing over the periphery. About eighteen of these can be counted on the outer whorl. The points of bifurcation are not marked by any distinct swellings or tubercles. Occasionally a simple and shorter rib intervenes between a pair of primaries, but the intermediate ribs are often wanting altogether, and when present never reach to the sutures. At first the costation is comparatively close set and the ribs, with their corresponding grooves, are subangular, but in the last half turn they get wider apart and more rounded. The whole sculpture is very coarse

for the size of the shell; in the only specimen of this variety, whose greatest diameter does not much exceed two inches, the ribs are as wide apart as they are in the largest example of the typical form, which is at least four times its size.

Septation unknown.

The exact dimensions of the fossils are as follows: Greatest diameter two inches and nearly four lines; width of umbilicus, about eight lines; height of aperture, five lines; breadth of do., one inch and three lines.

Ammonites Loganianus (?) Form B.

Plate VIII., figs. 1 and 1*a*.

Shell inflated, globose; the early volutions entirely concealed; umbilicus very small.

In the only specimen collected, the outer half of the last whorl is much distorted, and compressed in such a way that the sides are partly forced over the umbilical opening. For this reason the exact amount of the involution, the proportionate width of the umbilicus, and the shape of the aperture cannot be very accurately ascertained. Curiously enough, the distortion does not seem to have much affected the rest of the shell.

Only one whorl is visible externally; this is ventricose alike on the siphonal edge and at the sides; its inward curve is also convex, but rather abruptly so near the sutures. Where the distortion is least, the maximum width of the whorl (or thickness of the shell) is nearly equal to three-fourths of the greatest diameter. The aperture is obviously much wider than high, though it is difficult to estimate in what proportion. The umbilicus is very small and deep.

The surface is ornamented with primary, bifurcating costæ, and intervening, secondary, simple ribs. About thirty of the former can be counted on the last volution. They commence at the sutures, bifurcate at about a third of the distance across the sides, and reunite at exactly similar and opposite points. There are no swellings or tubercles on the ribs where they begin to divide. At the commencement of the last whorl the ribs bifurcate at a comparatively short distance from the sutures, but near the aperture this distance is much increased. The secondary costæ usually alternate with the primaries, but the former are often absent; when present they encircle the periphery but do not extend to the sutures. Two bifurcating ribs are occasionally placed together without any intervening one; or two simple costæ may occur be-

tween a pair of primaries. When the latter is the case, one of the intervening ribs is unusually long and almost joins one of the primaries, so that a tendency to bifurcation is then observable. The whole of the ribs are at first crowded and fine (except near the sutures) but at a little distance from the aperture they get much wider apart. They are prominent, regular and acute (though sometimes, under the lens, they appear a little rounded at their summits), and the grooves between them are rather deeply concave. In the earlier part of the outer whorl, the grooves are a little wider than the ribs which bound them, they (the grooves) gradually increase in width, until, near the aperture, they are about three times as wide and much shallower in proportion than at the commencement of the volution. The ribs, too, are more acute and prominent near the outer termination of the shell.

Septation unknown.

Where the specimen is least distorted the greatest diameter is about two inches, and the maximum width of the whorl (or thickness of the shell) is nearly one inch and a half.

It is doubtful whether the four Ammonites described above should be regarded as different stages of growth of one shell, or as two, or even three, distinct species. Form A. and form B. are each represented by a single specimen of about the same size. Notwithstanding its globose shape, and the much greater involution of its whorls, it is easy to understand that Form B. may be the young of the type of *A. Loganianus*, as there is little essential difference in the style of costation of both. The sculpture of Form A. is certainly coarser and its ribs are much more distant than is the case in any of the other three specimens; the costæ also appear to be more obtuse and angular, but as the surface is much waterworn, it is not safe to attach any importance to the latter character. In Form A. one volution and a half are visible externally, and in Form B. only one can be seen, but this difference may have resulted from the peculiar distortion to which the last named specimen has been subjected. On the whole, it is most probable that these four Ammonites belong to one species, of which Form A. may constitute a well marked variety.

In many respects, *Ammonites Loganianus* is nearly allied to the *A. Gervillei* of Sowerby. Form B., in particular, can scarcely be distinguished from the shell figured by D'Orbigny,* as the young state of *A. Gervillei*. In more fully grown specimens, the differences between the two species are obvious; *A. Gervillei* is then much the most globose shell of the two, and

* "Paléontologie Française. Terrains Jurassiques." Vol. II. Atlas, Plate CXL

has one more whorl visible externally. The volutions of *A. Loganianus* are coiled in a very similar manner to those of *A. bullatus*, D'Orbigny,* but the sculpture and shape of each are perfectly distinct.

The Oolitic Macrocephali, as a whole, are said to possess a combination of characters by which they can generally be distinguished from Cretaceous Ammonites of the same group. In the Oolitic species the shell is more globose, the whorls are very strongly involute, and, as Stoliczka has pointed out, "the lateral ribs form a tubercle about the middle of the sides, and then divide into two or more ribs." In each of these respects, *A. Loganianus* has more the aspect of an Oolitic than of a Cretaceous species.

The name proposed for this shell is intended as a tribute, of respect and affection, to the memory of the late Sir W. E. Logan.

Group IV.—Coronarii, Buch.

Sub-genus Stephanoceras, Waagen (Pars.)—"Geognostich-Palæontologische Beitrage." Munchen, 1869. Vol. II., page 248.)

Ammonites Richardsonii. (N. Sp.)

Plate V. Both figures.

Shell thick, inflated; umbilicus wide and deep, conspicuously coronated round its inner margin by a row of distant, rounded tubercles.

Volutions about six, very closely and tightly coiled, so that their width is about two-thirds greater than their height, much raised at the sides, widest and sub-angular near their middle. The amount of involution is always slight, and decreases exteriorly; the inner faces of the early volutions, and the whole of the sides of the last but one being fully exposed. In the outer whorl the periphery is ventricose and rounded; its curve is confluent with that of the outer half of the sides, which swell up (almost concavely) so as to form a sub-angular ridge about their middle, but nearer to the sutures. From the summit of this ridge, which forms the outer margin of the umbilicus, the whorls slope abruptly and almost precipitously down to the sutures, so as to present a nearly straight (though slightly convex) umbilical face. In the last half turn the umbilical margin becomes more rounded, and the inner face of the whorl is more oblique and spreading. As the greater part of one side of the only specimen collected is worn away, the exact width or thickness of the shell cannot be ascertained, but it was probably more than one-

* "Paléontologie Française. Terrains Jurassiques." Vol. II. Atlas. Plate CXLII., figs. 1 and 2.

half of the entire diameter. The umbilicus is deeply excavated and concavely conical, especially in the centre, but it gets shallower and loses its regularly conical shape near the aperture. As compared with the outer whorl, the inner volutions occupy rather less than one-half the greatest diameter of the shell. As measured from two opposite tubercles, the umbilicus is equal to nearly three-fourths of the whole diameter.

The aperture is transversely arcuate, and its sides are truncate and subangular.

The last whorl is ornamented with fourteen, distant, raised, rounded tubercles, which encircle the umbilicus. About as many can be counted on the volution which precedes it, and the coronations can be traced even in the earlier whorls. Where the test is preserved, the periphery and part of the sides are covered with close-set, numerous and transverse ribs, (varying from a quarter of a line to a line in width) which are too fine to leave definite impressions on the cast. These appear to proceed from each of the tubercles in bundles of about ten or fourteen. The distance from the centre of two contiguous tubercles on the outer whorl was found to be about seven lines, and in a space of equal width immediately below them, fifteen or sixteen ribs could be counted. These, however, are very unequal in width, even over a very small area, and, of course, are widest near the mouth.

Greatest diameter of the shell, four inches and five lines; extreme width of umbilicus, from the centre of two opposite tubercles, three inches and one line; of the inner whorls, (from suture to suture) two inches and one line. The breadth of the aperture is roughly estimated at two inches and nine lines in its widest part; its height is about eleven lines.

This interesting shell, of which only one imperfect specimen was collected, is nearly related to the *Ammonites coronatus** of Bruguiere, and *A. Blagdeni*† of Sowerby. The extreme fineness of the ribs in *A. Richardsonii*, together with the very slight involution of its outer whorl, will enable it to be distinguished from either at a glance.

It affords the writer much pleasure to be able to associate the name of its discoverer with this beautiful species. The collection of which it forms a part is only one out of the many additions which Mr. Richardson has made to our knowledge of the geology and palæontology of Canada, in a period extending over thirty years.

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* Paléontologie Française, Terrains Jurassiques. Vol. I. Atlas. Plates CLXVIII. & CLXIX.

† "Mineral Conchology." Vol. II., page 231. Plate CCI.

Group V. Planulati, Waagen, non Buch. (Coronarii, Buch. et auctorum, pars.)

Subgenus Perisphinctes, Waagen.—"Geognostich-Palæontologische Beitrage," von Dr. E. W. Benecke. Munchen : 1869. Band 2, p. 248.

Ammonites Skidegatensis. (N. Sp.)

Plate VII. Adult and type. Plate IX., figure 1 : An immature, but perfect specimen, supposed to belong to the same species.

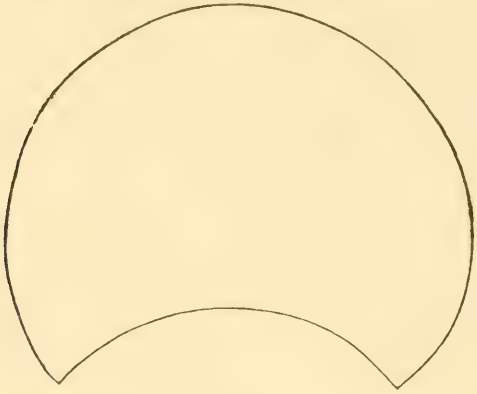

Fig. 4.

Fig. 4.—*A. Skidegatensis.*—Outline of aperture of the specimen represented at Plate VII.

Shell composed of many rounded whorls; umbilicus much more than half the entire diameter; surface regularly costate; ribs acute and separated by broad convex grooves, alternately bifurcating and simple. Volutions sharply coronated above and below.

The sides of the inner whorls are fully exposed; the umbilicus is accordingly very wide, it is also rather shallow externally, but is much deeper (apparently) near the centre. Measuring from suture to suture, the inner whorls (collectively) make up rather more than half of the entire diameter. Only the two outer volutions are visible in the largest specimen, the rest being covered by hard and tenacious shale, which could not be removed except at the risk of spoiling the fossil. As seen transversely, the outer whorl is raised at the sides, and slightly compressed at the periphery. Its base is shallowly and concavely emarginate by the encroachment of the preceding volution. The aperture is about one-third wider than high; its greatest breadth being a little below the middle.

The sculpture consists of transverse raised ribs, which although acute and prominent, are always narrower than the deeply concave and rounded grooves which separate them. What may be conveniently termed the primary ribs, commence at the sutures, bifurcate about the middle of the sides, pass over the periphery, and reunite at a corresponding point on the other plane of the shell. From thirty-five to thirty-six of these primary costæ can be counted on the last volution. At the point where they begin to bifurcate, they swell up into narrow and transversely elongated elevations, which can scarcely be termed tubercles, at least if that term is used solely to convey the idea of circular prominences. Sometimes, especially near the aperture, the bifurcation of the primaries is obscure, and the appearance then presented is that of pairs of continuous ribs, separated by one or two shorter ones. Occasionally, also, two bifurcating and primary costæ immediately succeed each other, without the intervention of any secondary rib. The secondary costæ are invariably simple, as well as being always shorter than the primaries. They encircle the outer half of the whorls only, and do not extend to the sutures, but become obsolete and disappear about the middle of the sides, just where the primaries begin to bifurcate. In the last whorl but one the arrangement of the costæ is very uniform; a single bifurcating rib almost invariably alternating with a shorter, simple one; but near the aperture the grouping is much more variable and irregular. As seen along the periphery, the whole of the ribs are both equidistant and of the same height; they are not separated by a narrow space which encircles the siphonal edge, (as is the case in some nearly allied species,) but pass uninterruptedly over it.

Septation unknown.

The greatest diameter of the largest known specimen, (to which the above description refers exclusively, and which must be regarded as the type of the species), is seven inches and two lines; the width of the umbilicus, from suture to suture, is about three inche and eight lines.

Besides the specimen just described, there are six small Ammonites which most probably belong to the same species, although the intermediate stages of growth have not yet been observed. The most perfect of these, which measures about two inches and three lines across, will be found represented at figure I. of Plate IX. The others are mostly mere fragments, but they show that the sculpture is very variable in different individuals of the same size, besides giving other information which happens not to be afforded by more perfect individuals. As compared with the type, the fossil figured on Plate IX. has its outer whorl proportio-

nately more raised at the sides and more compressed on the periphery, The inner faces of the whorl are more oblique and not so evenly rounded, and the umbilicus is rather less than half the entire diameter. These differences, however, may be partly due to the distortion which the small specimen has undergone; compression having been effected in a direction at a right angle to the sides. The umbilical cavity is concavely and rather deeply excavated in the centre, but it gets shallower rapidly as the shell increases in size. In this specimen there are not less than six volutions, and perhaps as many as seven. The costation, in this particular instance, is remarkably coarse for the size of the shell, and the intermediate secondary ribs are almost, if not altogether, absent. On the outer whorl there are twenty-four ribs, each of which proceeds from the sutures, and bifurcates about the middle of the sides. After bifurcating on one side of the shell, the ribs pass over the periphery, and re-unite (in this instance at least) at directly opposite and corresponding points, on the other. The linear elevations which arise at the points where the ribs bifurcate, are unusually prominent and give the shell a much more decidedly coronated aspect than it bears when it has attained to nearly its full size. Two out of these six small specimens shew a coarse style of ribbing, the ribs being exceptionally prominent and wide apart. Such individuals can scarcely be distinguished from the fossil figured by D'Orbigny in the "Paléontologie Française" * as the *Ammonites Braikenridgii* of Sowerby.† In that species the raised protuberances which arise where the ribs bifurcate, alternate with each other across the siphonal edge, instead of being placed at points immediately opposite, but an alternate grouping may also be traced obscurely in some of the Queen Charlotte Island specimens.

In the four remaining, the ribs, as they arise from the sutures, are as wide apart as in the others, but they either trifurcate before passing over the periphery, or else a single secondary rib alternates with each of the bifurcating primaries. Along the siphonal edge, therefore, the ribs in this variety are much more numerous and closer together than they are in the other.

In all the specimens, whether large or small, the sculpture is remarkably similar. The ribs are invariably acute, they are separated by concave grooves which are much wider than the costæ themselves, and the

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* "Terrains Jurassiques." Vol. II. Atlas, Plate CXXXV, figs. 3-5.

† The original description and figure *A. Braikenridgii* in the "Mineral Conchology," are so vague and unsatisfactory that it is by no means improbable that this name may have been bestowed by European writers on two very different species. Further, the shell represented by Pictet, in his "Traite de Paléontologie" (Atlas, Plate LV., fig. 1) as *Ammonites Humphreysianus*, seems to be identical with the *A. Braikenridgii* of D'Orbigny.

shape of the elevations which give a more or less coronated aspect to the shell, varies very little in different examples. Assuming that the whole of these seven Ammonites belong to one species, it was at first thought difficult to account for the fact that the width (or thickness) of the outer whorl in small individuals was so much greater in proportion to their entire diameter than is the case in more fully grown shells. The explanation of this circumstance is very simple. In a specimen at a comparatively early stage of growth, the whorls are so much compressed on the periphery and raised at the sides that the width of the aperture may be twice or even three times as great as its height. When more nearly arrived at maturity, the whorls become rounded and their sides compressed, the height of the aperture become nearly equal to its breath, and the result is a great addition to the diameter of the shell, which is not accompanied by a corresponding and proportionate increase of its thickness.

An appropriate illustration of this peculiar mode of growth is afforded by the *Ammonites anceps* of Reinecke, as figured by D'Orbigny in the "Paléontologie Française." In the Atlas to Vol. II, of the "Terrains Jurassiques," Plate CLXVI., figures are given of two specimens of *A. anceps*, one of which is represented as one inch and five lines, and the other as three inches and four lines in diameter. The smallest of these fossils is the thickest of the two, at least if the figures are correct.

Mr. Billings has suggested * that the large specimen which is here regarded as the type of *A. Skidegatensis*, is closely allied to the *Perisphinctes tyrannus* of Neumayr,† from the "Macrocephalen Kalken" of Brielthal. The two species certainly resemble each other in general shape and in the amount of involution of the whorls, but their sculpture is sufficiently distinct. The outer whorl of *P. tyrannus* is said to be ornamented with nineteen distant primary ribs, which trifurcate in passing over the siphonal edge. In *A. Skidegatensis* the ribs are much more numerous, acute and regular.

Ammonites anceps of Reinecke, which also belongs to Waagen's sub-genus *Perisphinctes*, is still more nearly allied to the present species both in shape and sculpture. The only important difference between them is that in the former the ribs are separated by a narrow space which encircles the periphery, and this is never the case in *A. Skidegatensis*.

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* "Geological Survey of Canada. Report of Progress for 1872-73." Page 72.

† "Jahrbuch der Kaiserlich-Koniglichen Geologischen Reichsanstalt." Vienna: 1870. Vol. XX., page 150, Plate IX.

Ammonites Carlottensis (N. Sp.)

Plate VI.

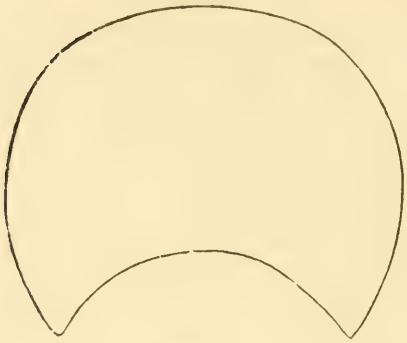

Fig. 5.

Fig. 5.—Outline of aperture of *A. Carlottensis*, as viewed transversely.

Shell composed of (apparently rather few) rounded whorls; umbilicus less than one-half the entire diameter. Volutions encircled by faint, though broad, obtusely rounded or subangular ribs, which are alternately bifurcating and simple. Sides bluntly coronated.

In the only specimen collected, the inner whorls are either covered by the matrix or are wanting altogether. The fossil also has been distorted in such a way as to present nearly an oval shape when viewed laterally, so that the proportion of the umbilicus to the entire diameter varies according to the direction in which it is measured. The same distortion seems to have affected the shape of the outer whorl; at any rate, near the aperture it is compressed both at the sides and on the periphery, while the other half of the same whorl is inflated, the periphery is evenly rounded, though perhaps a little flattened, and the sides are very much raised. As the inner edge of the whorls is usually rounded, there is no distinct margin to the umbilicus; in some places, however, the umbilical face of the whorls is steep, but it is never angular above. Measuring from suture to suture (of the outer whorl) the inner volutions occupy between one-third and one-half of the diameter of the shell. The aperture is always much wider than high; the emargination at its base (caused by the encroachment of the preceding whorl) being moderately deep, or at least, not very shallow.

The outer whorl is ornamented by nineteen primary ribs; these commence at the sutures, and swell out gradually into obtuse, elongated, but more or less rounded tubercles about the middle or near the inner half of

each side, after which they bifurcate widely, but very indistinctly, before passing over the periphery. In the earliest part of the whorl, two simple, secondary ribs, which do not quite reach to the sutures, usually intervene between each pair of primaries. Near the aperture the secondary costæ disappear, and the ribs as they pass over the siphonal edge become much more distant. As viewed along the periphery, the whole of the ribs are about equidistant, the intermediate ones being as broad and as wide apart as the bifurcations of the primaries. The entire costation is peculiar in another way; the ribs, though wide, are obtuse and not much elevated, and the corresponding depressions, though broad, are always very shallow. At some distance from the aperture, where the test is preserved, both ribs and grooves are obtusely angular. Near the outer edge of the volution they become more obsolete as well as wider, and probably with age disappear altogether.

Septation unknown.

Greatest diameter of the shell, five inches and ten lines; maximum width of umbilicus, (from suture to suture) two inches and five lines. Height of aperture, one inch and three and a half lines; greatest breadth of do., twenty-three lines.

The above description refers exclusively to the solitary and imperfect specimen collected by Mr. Richardson, which is represented at Plate VI. Although only partially characterized at present, the species seem to possess sufficiently distinctive features to entitle it to the new name which is here proposed for it. The sculpture of *A. Carlottensis* is not very dissimilar to that of *A.* (Perisphinctes) *tyrannus*, but the shape of the two shells is quite different. In *A. Carlottensis* the umbilicus is comparatively small, in *A. tyrannus* it is very wide. In the former, when undistorted, the inner whorls together would probably occupy about one-third of the entire diameter; in the latter they would make up more than half. *A. Skidegatensis* resembles *A. tyrannus* in shape but not in sculpture, while *A. Carlottensis* is allied to *A. tyrannus* in sculpture but not in shape.

Ammonites Laperousianus. (N. Sp.)

Plate III., figure 3.

Shell composed of many rounded but slightly compressed whorls; umbilicus about one-half of the entire diameter; surface marked by simple, transverse ribs, and by numerous, oblique, periodic constrictions

Volutions about six, increasing slowly in size, the sides of the inner whorls being almost completely exposed; outer whorl nearly circular, but a little compressed at the sides, its base being shallowly emarginate by the preceding volution; aperture slightly wider than high.

Surface ornamented with simple, transverse, flexuous ribs, and oblique, periodic grooves or constrictions. As the direction of the constrictions is different to that of the ribs, some of the latter are almost always truncated by the former. In the outer whorl of the specimen figured, there are nine or ten constrictions, each of which is narrow on the periphery and wide on the inner half, at least, of the sides. They divide the ribs into sets in a somewhat uniform way. Near the aperture there are generally six ribs between each pair of grooves. Of these, the first three are continuous, as is also the sixth, or outer one, which is so oblique as to truncate about one-half of the fifth, near the middle of the sides, and the base of the fourth, near the sutures. Or, it might be said with equal propriety, that the outer rib trifurcates at unequal distances, before passing over the periphery. In each set of ribs, the two outer ones form part of the boundaries of the grooves by which they are separated. Both ribs and constrictions become faint and nearly obsolete on the periphery, especially the former. The constrictions are obviously the remains of former lips, which were sinuous at the sides, and produced into narrowly rounded, or spout-like processes, on the siphonal edge of the shell.

Septation unknown.

Greatest diameter of the largest example, nineteen lines; width of umbilicus, from suture to suture, not quite nine lines.

The description applies solely to the specimen figured, which is the largest of the only two collected. The other one, which measures scarcely an inch across, is comparatively flat and thin, its aperture is much higher than wide, and the ribs and constrictions are not so clearly defined as they become at a more advanced stage of growth.

There is a considerable resemblance between these shells, which are obviously very immature, and the *A. Seranonis* of D'Orbigny,* a French Lower Neocomian fossil. D'Orbigny's species is represented as having a thinner and flatter shell than is that of *A. Laperousianus* at the same age. Young specimens of the latter are indeed nearly as flat as the French fossil, but the umbilicus of the smallest of the two individuals

* "Paléontologie Française. Terrains Cretaces." Vol. I., page 361, Atlas, Plate CIX;, figs. 4 and 5.

from the Queen Charlotte Islands is then comparatively small. In the outer whorl of *A. Laperousianus* there are nine or ten oblique grooves or constrictions, in that of *A. Seranonis* there are only four.

Septation unknown.

Inscribed to the memory of the gallant Commander of the *Astrolabe*, who visited these islands in 1786.

A. Laperousianus probably belongs to Dr. Waagen's sub-genus Perisphinctes, the young shells of which are said to be marked by periodical constrictions. Other writers regard these marks of arrests of growth as one of the distinguishing features of the *Ligati*, and the species is evidently one of the connecting links between that group and the *Planulati*. Its full characters have yet to be ascertained.

Group 6. *Ligati, D'Orbigny.*

Ammonites Timotheanus, Mayor.

Plate III., figures 2, 2*a*.

A. Timotheanus, Mayor. Pictet et Roux. "Mollusques des Gres Verts," page 39. Plate II., fig. 6, and Plate III., figs. 1, 2. Stoliczka, "Cretaceous Cephalopoda of Southern India." Series 3, parts 6-9, pages 146, 147, Plate LXXIII., figures 3 to 6.

Shell composed of rather closely involute, nearly square whorls, which become rounded with age; umbilicus about one-third the entire diameter; surface almost smooth, but marked by distant, periodic constrictions.

As far as can be ascertained from the rather imperfect specimens, about one-fourth of the inner whorls is exposed. In two of these, whose diameter is less than as many inches, the periphery of the outer whorl is flattened, the sides are obliquely compressed, and the umbilical faces are straight and steep. The squareness of the whorls is very marked at this stage of growth, but the outer angles are more rounded than the inner ones. Their aperture is subquadrangular, and wider than high, even if the basal emargination (which is squarish and moderately deep) is not taken into account. The proportions of the umbilical opening are best seen in these half grown shells. In an individual whose greatest diameter is fourteen lines, the width of the umbilicus is five lines; its margin is bluntly angular. A larger but less perfect specimen, which measures nearly three inches and a-half across, has nearly circular whorls, but they are still a little compressed at the sides. Its aperture is ovately orbicular, but widest

below, and the basal emargination is rather deeply concave. If measured outside of the emargination, the height of the aperture is rather greater than the width; if in the centre, the width slightly exceeds the length. In other words, the lateral compression of the whorls is so little, that it is not equal to the depth of the emargination. In the adult shell, the umbilical margin is evenly rounded.

The sculpture consists for the most part of obliquely transverse distant, periodic furrows or constrictions. About six of these can be counted in the outer whorl of each of the specimens; they are directed obliquely forwards on the sides, and then bend backwards so as to form a series of shallowly concave sinuses on the periphery. Besides these, there are a few faint revolving lines on the siphonal edge, and some still fainter striæ of growth across the whorls, but both are so inconspicuous that, apart from the narrowly concave constrictions, the surface is practically smooth.

Septation unknown.

The three Ammonites described above agree so exactly with Stoliczka's description and figures of *A. Timotheanus*, that they are provisionally (at least) regarded as belonging to that species. In the absence of any definite knowledge of the septation of the Queen Charlotte Island specimens, their identification is, of course, somewhat uncertain. The memoir in which *A. Timotheanus* was first described is, unfortunately, inaccessible to the writer. According to Stoliczka, Pictet originally recorded it as a fossil of the "Gres Verts" of Saxonet in Savoy. It was afterwards noticed by D'Orbigny, Gras and others, from the Gault and Etage Albien (Lower Chalk) of the South of France. Hauer thinks that specimens of an Ammonite from the Gault of South-Western Hungary may belong to this species. In India, *A. Timotheanus* has been collected from the "Trinchinopoly Series of Serdamungalum, North of Anapaudy and near Ondoor;" also from the "Ootatoor Series of the neighbourhood of Odium: Mooraviatoor and Penangoor." It was first catalogued as a British fossil in 1875. In the Quarterly Journal of the Geological Society of London (Vol. XXXI., pp. 277 and 306), Mr. A. A. Jukes Brown says that it is found, though rarely, in the phosphatic deposits of the Upper Gault, or "Etage Vraconnien," at Cambridge.

Group 7.—Fimbriati, D'Orbigny.

Sub-genus Lytoceras, Suess. (Thysanoceras, Hyatt.)

AMMONITES FILICINCTUS (N. SP.)

Plate II., Figs. 2, 2*a*, 2*b*, 2*c*, and 3.

Shell composed of many, slightly involute whorls, which are nearly circular in section when half grown, but which become a little compressed laterally with age. Surface ornamented with minute, crowded, transverse, raised lines, and with numerous periodic furrows or constrictions.

Whorls about six or seven, two-thirds or more of the inner ones being exposed. In a specimen (Plate II., fig. 2) which measures about an inch and a quarter in diameter, the outer whorl is rounded, but compressed slightly and obliquely at the sides, while the downward and inward curve towards the sutures is abrupt and sub-convex. At this stage of growth the aperture is broader than high; its outline is almost circular, but the base is shallowly emarginate. In a fragment of a much larger and undistorted specimen, the oblique flattening of the sides is more decided, and the outline of the aperture is rather more elliptical.

The true proportions of the umbilical opening can be seen only in the small specimen represented at Plate II., fig. 2, the others are either imperfect or crushed out of shape. In this individual, the width of the umbilicus (the margin of which is rounded and indefinite) is not quite half of the entire diameter.

The whole surface of the test is encircled by fine, transverse, thread-like striæ or raised lines, which are scarcely visible to the naked eye and give to the shell a silky lustre. The striæ are nearly straight on the periphery, but flexuous on the sides and inner margins of the whorls. They are parallel, simple, and nearly equidistant; never either crenate or bifurcating. Besides the striæ, the whorls are girdled by periodic, transverse furrows or constrictions, which occur at irregular and sometimes distant intervals, in half-grown shells. In the outer whorl of large specimens, these furrows become more numerous and regularly disposed, so that when viewed at a little distance, the sculpture near the mouth seems to consist of broad flattened ribs, separated by deep, though comparatively narrow, grooves. It requires a closer inspection to detect the thread-like striæ on the surface of each rib, but although they (the

striæ) are sometimes obliterated on the cast, they are always clearly defined when the shell is preserved. In the last whorl of a large but distorted specimen, seventeen of these rib-like spaces can be counted, which average about a quarter of an inch in width, the grooves being about half as wide. It is scarcely correct to call the spaces between the grooves ribs, for, although the furrows sink deeply below the general level of the surface of the shell, there are no corresponding elevations above it. Sometimes the spaces are as much as half an inch wide.

The outlines of the septa can only be traced in a half-grown specimen (the original of Plate II., fig. 2) and in it they are partly covered by the shell. The siphonal ("dorsal") saddle is small, *simply conical and entire*. Its sides are slightly convex, but they are not toothed or cut. There are two bipartite lateral lobes and saddles, with bifid terminations, on each side. The first lateral lobe, which is the largest, is about as long as the siphonal one. The number of accessory lobes and saddles between the umbilical margin and the sutures of the whorls cannot be made out very satisfactorily, but as the second lateral lobe is placed on the edge of the umbilicus, they must be very few.

Five specimens of this species were collected, three of which are either imperfect or much distorted.

These shells agree exactly, both in shape and sculpture, with the figures and descriptions of *Ammonites Sacya*, Forbes, as given in the "Palæontologia Indica." Stoliczka's illustration of the type of *A. Buddha*, Forbes, (a synonym of *A. Sacya*) would serve as a portrait of the specimen represented at Plate II., fig. 3. Yet the septation of the two species is not alike, the principal difference being in the shape of their siphonal saddles. Those of *A. Sacya* are said to be tongue-shaped and toothed, ("sella siphonali denticulata, linguiforme") while those of *A. filicinctus* are conical and entire.

A. filicinctus is also nearly allied to *A. quadrisulcatus*, D'Orbigny, especially in the outlines of its septation, the siphonal saddles being of the same shape in each. *A. quadrisulcatus* was at first imperfectly described (in the "Paléontologie Française") from half-grown casts. It has since been illustrated rather copiously by Zittel, in the "Cephalopoden der Stramberger Schichten," also in the "Fauna der Aelteren Cephalopoden Fuehrenden Tithonbildungen," and Tietze has figured a variety of it in the "Jahrbuch der Kaiserlich-Koniglichen Geologischen Reichsanstalt" of Vienna, Vol. XXII., (1872) Plate IX., figs. 12*a* and 12*b*. In Zittel's diagnosis of *A. quadrisulcatus* no mention is made of any transverse striæ, although some rather distant ones are represented in his

figures. On the other hand, close, thread-like striæ, similar to those which are so characteristic of *A. filicinctus*, are shown in Tietze's illustrations of *A. quadrisulcatus*, although nothing is said about them in the text. Zittel says there are never more than four transverse grooves to each whorl of *A. quadrisulcatus*, but Tietze figures a variety with five. In a large though distorted specimen of *A. filicinctus*, there are at least sixteen grooves or constrictions on the outer whorl, in the inner ones even they are often very numerous. By this latter character *A. filicinctus* may be readily distinguished from D'Orbigny's species.

The aperture of the original of Plate II., figs. 2*a* and 2*b*, presents an appearance which gave rise to a curious mistake. It is almost filled with small white crystals of calcite, but in the centre of the inner margin of the whorl there is a dark coloured ring, (like the rough end of a tube) and this was at first thought to be the siphuncle. On making a transverse section of the shell, at nearly a right angle to the mouth, a similar appearance was seen in one part of the surface exposed. On a careful re-examination of the specimen with a lens, traces of the true siphuncle were found in the ordinary position on the periphery, and the illusive nature of the other was then apparent. It would have been superfluous to mention this circumstance, but as figure 2*b* (on Plate II.) might otherwise mislead, it is as well to state that it was intended to represent the appearance presented by a section of the original of figure 2, with special reference to the position of the supposed siphuncle. In this figure, what seem to be the outlines of the inner whorls, as well as the presumed siphuncle, (which by accident is placed a little too high up) are caused by adventitious matter in the interior of the shell.

Ammonites Crenocostatus. (Provisional name.)

Plate IX., figs. 2, 2*a*.

(Perhaps a half-grown specimen of *A.* (Lytoceras) *Liebigi*, Oppel.
Compare Zittel's Cephalopoden der Stramberger Schichten," especially Plate IX., figures 6*a*, 6*b* and 6*c*.)

Shell composed of many loosely coiled, and scarcely involute, rounded whorls, whose convex surface is encircled by numerous fine, transverse and minutely crenate raised lines.

Volutions about five or six, nearly circular in outline, but a little compressed at the sides, and then sloping rather suddenly inwards and downwards to the sutures, which are very deeply excavated; periphery

rounded. The amount of involution is very small indeed, and the inner whorls are well exposed. They occupy a space about equal to one-half of the entire diameter. The aperture is ovately orbicular, except at the base which is very slightly emarginate; its height and breadth are nearly equal.

The sculpture characteristic of the species is best seen in the last half turn. It consists of transverse, raised lines, which are found to be minutely crenate when examined with a lens. They are placed at irregular intervals (of from one-sixth to one-eighth of an inch in width,) upon the convex surface of the shell, and are not separated by any corresponding grooves or depressions. Near the aperture there are a few indistinct, but rather crowded revolving lines on the periphery and outer half of the sides. A few faint transverse grooves, or constrictions, (the remains of former lips) also cross the whorls at irregular but distant intervals. Four of these can be counted on the last volution.

The septa form three lobes on each side, of which the two outer ones at least are very deeply and somewhat numerously divided; the second lateral lobe is placed on (or near) the umbilical border, and a single accessory one on the inner margin of the whorls. The first and second lateral lobes and saddles are bipartite with bifid subdivisions; the dorsal lobe is nearly as long as the first lateral, which is the broadest; the siphonal saddle appears to be elongate-conical, simple and entire; it is about one-half the height of the first lateral; the outer branches of all the saddles are scarcely longer than those of the inner ones.

Greatest diameter, one inch and nine lines; do. of the inner whorls, nine lines; width of the outer whorl rather less than seven lines; height of the same, as measured from the outside, rather more than seven lines.

As there is only one small specimen available for comparison, which does not show the characters of the septation very clearly, it is doubtful whether this shell should be regarded as identical with the *Lytoceras Liebigi* of Oppel, or as a distinct species. So far as figures of the European fossil enable one to judge, there are certainly some differences between the two at the same age, but these are slight and, perhaps, unimportant. In young shells of *L. Liebigi*, the amount of involution of the whorls is greater than is the case with those of the Queen Charlotte Island shell. The surface of the outer whorl of *L. Liebigi* is then marked with three or four transverse raised ridges, which are so prominent as to break the curve of its outline; the few constrictions across the last volution of *L. crenocostatus* are bounded by scarcely perceptible elevations. The latter is also rather the flattest of the two shells. Under all the

circumstances it is deemed advisable to keep the two species separate, at least for the present, and a provisional name has been suggested, accordingly, for the fossil collected by Mr. Richardson.

Group 8.—*Doubtful Species.*

AMMONITES (Sp. undt.)

Plate III., figures 4, 4*a*.

Compare A. simplus D'Orbigny.

"Paléontologie Française. Terrains Cretaces." Vol. I., pages 208-9. Atlas, Vol. I., Plate LX., figs. 7—9.

Shell strongly involute, globose, the thickness being about a fifth less than the greatest diameter; umbilicus small but deep; periphery rounded; aperture much wider than high. Surface nearly smooth, marked only by a few lines of growth.

Septation unknown.

Diameter of the only specimen five lines; maximum thickness about four lines; width of umbilicus rather less than one line.

This little shell can scarcely be distinguished from the *A. simplus* of D'Orbigny, as figured and described in the work just quoted. On the other hand, many Ammonites have a globose, nautiliform shell in their very young state, so that this fossil is probably only an early stage of growth of one of the species previously described, though, owing to the want of a series of specimens of all ages, it is at present impossible to say of which.

Not a little difference of opinion exists as to what are the true relations of D'Orbigny's *A. simplus*, which is generally believed to be the young of some other species. D'Orbigny himself has united it with his *A. verrucosus*, a decision in which he has been followed by many palæontologists. Stoliczka disputes the correctness of this view, and with much apparent justice. In the "Index Palæontologicus," (Vol. I., pages 49 and 59.) Bronn places *A. simplus*, though with a note of interrogation, (implying a doubt as to the propriety of the reference) among the synonyms of *A. macrocephalus*, Schlotheim. This suggests the idea that the present shell may be the young of *A. Loganianus*, nobis. Zittel includes *A. simplus* in his genus *Aspidoceras*, and the fossil just described is certainly very like the early stage of Oppel's *A. cyclotum*. As the *Ammonites Stoliczkanus* of Gabb has many of the characters of *Aspidoceras*, this little shell may be the young of it.

Hamites (?) (Sp. undt.)

Plate IX., figure 3.

Compare Hamites elegans, D'Orbigny.
"Paléontologie Française. Terrains Cretaces." Vol. 1., pages 542 and 543. Atlas, Plate CXXXIII., figs. 1 to 5.

A single fragment of a cephalopodous shell, about an inch in length by four lines in diameter, which is referred to this genus with much doubt.

The specimen is quite straight and does not decrease in width very perceptibly. As viewed transversely, its outline is compressed ovate, the greatest width of the ovoid being across what is presumed (by analogy) to be the siphonal edge.

The surface is marked by transverse but slightly oblique ribs, which are narrower than the shallowly concave grooves which separate them. There are also three pairs of obtusely rounded tubercles on the periphery. The tubercles of each separate pair are very close together on the siphonal edge, being scarcely more than a line apart, but the pairs themselves are placed at distant intervals along the length of the shell. The arrangement is uniformly as follows:—five simple and non-tuberculate ribs encircle the shell obliquely, and between each set of five, two or three ribs intervene, which, together, bear a pair of tubercles. Each of the latter are wide enough to embrace two or three ribs. The distance between two pairs of tubercles is generally about one-third of an inch, measuring from the centre of the summit of each.

This species is placed in the genus *Hamites*, principally on account of the strong resemblance which it bears to the *H. elegans* of D'Orbigny, of which it may prove to be an extreme variety. Still, the Queen Charlotte Island fossil is flatter than *H. elegans*, and seems always to have five uninterrupted ribs between those which bear the tubercles. In D'Orbigny's species there appear to be never more than four, and sometimes only two non-tuberculated ribs in each set.

GASTEROPODA.

Amauropsis Tenuistriata, (N. Sp.)

Plate IX., figs. 4, 4a.

Shell subovate, spire short, body whorl about three-fourths of the entire length; umbilicus entirely closed.

Whorls four, the early ones rounded but somewhat angular above and a little compressed at the sides; the sutures becoming more distinctly impressed as the shell increases in size. In the last volution and in part of the preceding one, the upper sutural edge is flattened, and forms a blunted angle with the side, the suture itself being lightly channelled. Below the narrow sutural shoulder the body whorl is flattened or slightly concave above the middle; beneath, or about the centre, it becomes moderately ventricose, and then narrows suddenly to the base. The umbilicus is completely covered, and this is partly due to a thickening of the columellar lip above. The aperture is rounded exteriorly, while on the columellar side its outline is concave above and convex below; the base seems to have been obtusely pointed.

The surface ornamentation consists of minute, transverse, raised striæ, which are rather irregular, and show a tendency to become arranged obscurely in bands. These transverse and crowded striations are crossed by similar though much more distant revolving lines, whose disposition is very variable. On the penultimate volution the decussation is extremely minute, but it appears to cover the whole area. On the body whorl the revolving striæ seem always present at or near the shoulder, and generally, though not always, in the centre of the volution. In every case the revolving striæ are much fainter than the transverse ones, and the former are often obsolete.

Total length of the largest specimen, rather more than nine lines from the apex to the base; height of body whorl about seven lines; maximum width of do., about six and-a-half lines.

Seven specimens of this species were collected, two of which are mere casts. None of them are quite perfect, although in two the characteristic sculpture is well preserved, and the description is, accordingly, compiled from a general average of the features shown by the whole collectively.

Pseudomelania (?) (Sp. undt.)

A fragment of a large spiral shell, consisting only of about two and a half of the basal whorls, which may belong to this genus. The test is partly preserved on the last two volutions, but it is absent on nearly the whole of the upper whorl. Apart from the sutures, there are no spiral grooves on any part of the cast, and the shell is presumably therefore not a *Neritwa*. The specimen is clearly part of an elongate, subulate shell, with smooth or only faintly striated whorls, and with the sutures not very deeply impressed. The volutions are much flattened, and the last one is

more than twice as high as that which precedes it. The test also is rather thick.

So far as can be ascertained from such an imperfect specimen, this species seems to be nearly related to such shells as the *Melania Heddingtonensis* of Sowerby,* to the *Chemnitzia Athleta* † D'Orbigny, and to other similar species described by the latter writer. Sowerby, indeed, describes his *M. Heddingtonensis* as having an infra-sutural carina, but that character is so often absent that it is not represented at all in any of the five figures of the species in the "Terrains Jurassiques."

The genus *Pseudomelania* was constituted by P. De Loriol for the reception of the large, smooth and elongated Oolitic fossils formerly referred to *Melania* and latterly to *Chemnitzia*. The so called *Chemnitziæ* of the Mesozoic rocks may have had tolerably near affinities with such genera as *Eulima* or *Eulimella*, but scarcely with the minute recent shells, with cancellate sculpture, once referred to *Chemnitzia* but now usually included in Risso's genus *Turbonilla*.

The nearest Cretaceous representatives of this species are the *Turritella Renauxiana* and *Eulima amphora* of D'Orbigny.

Scalaria Albensis (? ?) D'Orbigny.

Plate IX, figure 5.

Scalaria Albensis, D'Orbigny. "Paléontologie Française, Terrains Crétaces," Vol. II., pp. 51, 52. Atlas, Plate CLIV., figs. 4 and 5.

The fragment represented on Plate IX agrees remarkably well, so far as it goes, with D'Orbigny's descriptions and figures of the *Scalaria Albensis*, a Lower Neocomian fossil from the Department of Yonne, in France. The original diagnosis of that species is as follows:—"S. testâ turritâ, imperforatâ, transversim tenuiter striatâ, longitudinaliter costatâ: costis flexuosis, obtusis, anticè posticèque evanescentibus; spirâ angulo 13°, ultimo anfractu non carinato; aperturâ subrotundatâ." The mouth of the only specimen from the Queen Charlotte Islands is broken off, but otherwise the characters of both seem identical.

On the other hand, there is reason to doubt whether some of the Cretaceous shells placed by D'Orbigny in the genus *Scalaria* really belong to the family Scalidæ. In an article on Cretaceous Gasteropoda, contributed to the "Geological Magazine," for March, 1876, the author, Mr. J. Starkie

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* "Mineral Conchology." Plate XXXIX, figure 2.

† "Paléontologie Française. Terrains Jurassiques." Plate CCXLV, figure 1.

Gardner, says of *S. Clementina* Mich., "I have had an opportunity of examining the original of D'Orbigny's figure in the 'Paléontologie Française' at the Ecole des Mines, and find that the drawing represents the whorls more convex and inflated than they really are, and *the aperture is a restoration.* Again, speaking of *S. Dupiniana* D'Orbigny, the same writer says :—"The mouth is very imperfect, and has evidently been restored in the drawing." So rare is it to find the aperture perfect in shells of this group, that out of twenty British species supposed to belong to the Scalidæ, Mr. Gardner has only seen one with the outer lip perfect.

The distant rib-like folds which become obsolete above and below in Mr. Richardson's specimen, are very unlike the varices of *Scalaria* or *Opalia*, which are not only continuous from suture to suture, but which also frequently traverse nearly the entire length of the shell. The relations of the present species are probably nearer to *Aporrhais*, or even to *Potamides* or *Cerithidea* in the family Cerithiadæ, than to the Scalidæ.

Mr. Gardner justly remarks ("Geological Magazine," February, 1876, page 76), "There is some analogy between fragments of *Scalaria* and *Aporrhais* when the last whorl is not present." It is difficult to detect much difference between the present fragment and the shell figured by Sowerby* as *Rostellaria elongata*, except that the whorls of the former are very much flatter and less conical than is the case with the much better specimens of the same shell recently figured by Mr. Gardner as *Aporrhais elongata.*

Possibly the affinities of the Queen Charlotte Island shell may have been with some of the European Wealden or Purbeck fossils (such as *Potamides attenuata, tricarinata* and *harpæformis*) formerly referred to *Melanopsis* but now included in Brongniart's genus *Potamides.*

Pleurotomaria Skidegatensis. (N. Sp.)

Plate IX, figures 6, 6a.

Shell turbinate-conical, wider than high; spire shorter than the body whorl; umbilicus deep but narrow, less than one-third the diameter of the base. Whorls five, those of the spire bluntly and obscurely angulated about the middle. The angulation is scarcely perceptible in the first two volutions, but the two specimens yet obtained are much worn; the apex appears to have been obtuse. Below the central angle the

* "Transactions of the Geological Society of London." Second Series, Vol. IV., page 336, Plate XI, fig. 6.

whorls of the spire are compressed in a direction nearly parallel with the axis; above it the flattening is oblique but almost horizontal. The body whorl is also bluntly but conspicuously angulated at, or a little below the middle; the upper half is obliquely flattened, and the base is depressed and gently convex. The outer lip is angular below the middle, also at its base; the columellar lip is nearly horizontal, and together with the outer lip, merges into the commencement of the next volution above. Behind the columellar lip there is a deep but narrow umbilical excavation, but this does not apparently expose any of the inner whorls.

The shell is everywhere encircled by revolving raised lines. Below the mesial angle of the body whorl these are simple, equidistant and regularly arranged. Although moderately prominent, they are obtuse and rounded; the grooves between them are about equal in width to the lines themselves. Upon the whole of the spire and on the upper half of the body whorl the revolving lines are finer, more irregularly disposed and show a decided tendency to arrangement into bundles. On the upper part of the shell the revolving striæ are crossed by obliquely transverse lines, which in one instance, at least, are directed backwards. These are entirely absent on the basal portion. The transverse striations are not interrupted by the revolving lines, except perhaps at the median angle upon which the band of the sinus is placed, but pass continuously over them. The effect is that the revolving lines have a more or less beaded appearance, and this is particularly well seen above and below the median angle of the penultimate and antepenultimate whorls. The beading is rather distant, and seems to become obsolete near the aperture.

The "band of the sinus" is only seen in a single place on the penultimate whorl of one of the specimens. It is flattened above and below, and its centre is traversed by a single, clearly-defined, raised line; its whole area being marked by close set, fine and delicate striations. These latter are each shaped like a V placed sideways, the apex of the letter being directed backwards. They run almost exactly parallel to each other, but are so minute as to be scarcely visible to the naked eye. No distinct margin can be traced on either side of the band, but the sculpture of this part of the shell is very imperfectly shown at the best.

Only three examples were collected, one of which is a mere cast. The other two are so much distorted that the exact measurements could not be ascertained. The shell is only partly preserved on these, and the figures therefore on Plate IX. are partly restorations. The specimen

selected for illustration happens to be distorted in such a manner as to make the transverse striæ appear to be directed forwards, but in another individual they certainly incline backwards, and this is probably their normal arrangement.

ACTÆON, (Sp. undt.)

In breaking up some pieces of shale from either Maud or Lina Island, six specimens of a small gasteropod were discovered, which perhaps belong to this genus. The test is not preserved in any of them, so that their distinctive features are unknown, and it is also doubtful whether there are two species, or only two different stages of growth of the same shell. Four of these are composed of three whorls, of which the last one is at least three times as high as the spire. The general shape is ovate; the body whorl is inflated and evenly rounded above; the sutures are not channelled. In the two remaining specimens the spire is broken, but the body whorl is narrowly cylindrical and much elongated, it is distinctly shouldered and angular above, and the sutures (of the cast) are deeply grooved. The whole of the specimens have one feature in common, and that is that the last volution of the casts is encircled or impressed by revolving grooves.

No traces of a thickened lip can be detected, and these little shells are therefore placed in Montfort's genus *Actæon* (of which *Tornatella*, Lamarck, is a synonym) though they may possibly prove to be *Cinuliæ*.

ACTÆONINA, (Sp. undt.)

A narrowly cylindrical and short-spired shell which very closely resembles some of the European Oolitic Actæoninæ, is abundant in pieces of shale from the islands in Skidegate Channel. The specimens occur as mere casts, which have been subjected to almost every variety of compression and distortion. In an average example, about an inch long the body whorl occupies nearly eleven-twelfths of the entire length. It is bluntly angular above, and faintly striated longitudinally. In some specimens the apex of the spire is obtuse, in others it is acute. The umbilicus is entirely closed, and no traces of any plaits at the base of the columella could be detected, though the latter circumstance may be attributable to the imperfect state of preservation of the fossils. They are indeed in such bad condition that their generic position even is uncertain.

LAMELLIBRANCHIATA.

Martesia (?) carinifera. (N. Sp.)

Plate IX, figure 7.

Shell tumid and ventricose in front, narrow and attenuate behind; about one-third longer than high. The thickness at the anterior end equals or slightly exceeds the height, and the posterior compression is much greater in a lateral than in a horizontal direction.

The superior border is straight, but slopes gently downwards to the posterior end; the umbonal region is swollen and the antero-dorsal margin is raised and rounded. The beaks themselves are anterior, terminal, prominent, incurved and approximating. The lower half of the anterior margin is truncate obliquely, though almost horizontally; its base is rounded, and above the middle it seems to have been produced into a more or less rounded lobe on each side, which extend upwards so as to just touch each other immediately below the beaks. The edges of the valves at this end are a little broken in the only specimen collected, so that the outline of the anterior extremity cannot be very clearly ascertained. The pedal opening or anterior gap is large and wide, it appears to have been nearly diamond-shape, but the upper half probably had concave sides, and was shorter than the lower. The height and width of the pedal opening were apparently about equal.

The posterior margin is obliquely subtruncate, bluntly angular and pointed below, less so above. The ventral border is straight, but trends slightly upwards towards the posterior end: its termination in front is abruptly rounded, and bluntly angular behind.

On each valve a slightly flexuous raised ridge runs obliquely from behind the beaks to the posterior end of the basal margin, and separates a small, excavated and nearly triangular posterior area, from the central part of the shell. The middle of the valves is also divided by two transversely oblique and slightly divergent grooves (which pass from the beaks to the ventral margin) into three unequal and differently shaped spaces. Of these, the posterior is the largest, the centre one the smallest, while the anterior space is of medium size. The latter is marked near its front boundary by two raised lines, which pass from the beaks to the base, and in so doing cut or divide off, as it were, the two lobes at the front end from the main body of the shell.

A small portion of the test is preserved on one of the valves, and under

the lens its surface is seen to be minutely and concentrically ribbed, the ribs following the general outline of the shell.

Length, three and-a-half lines; greatest height about two and-a-half lines; maximum width (or thickness) about equal to the height.

A single specimen, burrowing into fossil wood.

The solitary example from which the above description was made, is both imperfect and immature. At present it is not known whether the anterior hiatus was permanently open or closed in the adult by a calcareous secretion. Not a vestige of any of the accessory plates remains, and their number, shape and position have yet to be ascertained. The generic position of the shell can, therefore, only be inferred by analogy, and that in a very vague and unsatisfactory way at best.

The somewhat elongated shape, coupled with other characters, indicate that the species should be referred to the Pholadinæ rather than to the Teredinæ, and its relations are apparently either with *Martesia* or *Parapholas*. The essential distinction between these genera is that in *Parapholas* the umbonal accessory valve is "longitudinally divided in two," while in Martesia it is single and entire. Stoliczka* is of opinion that "the distinction scarcely deserves to be regarded of generic value." Woodward† defines the genus *Parapholas* briefly thus, "valves with two radiating furrows." Stoliczka‡ says "the two furrows running from the umbones towards the periphery are said to be present in all known species of *Parapholas*," and a part of Tryon's diagnosis of the genus § is, "surface impressed by two oblique sulci, extending from the beaks to the margins."

Conrad's genus *Parapholas* was proposed by him in 1849, and the type species is admitted to be the *Pholas Californica* of the same author, which has only one groove on each valve! In describing that species the writer says, "valves much contracted submedially, with an oblique groove." Chenu accordingly calls *P. Californica* a *Martesia* and not a *Parapholas*.

Tryon, whose monograph on the recent Pholadaceæ (in the "Proceedings of the Academy of Natural Sciences of Philadelphia for 1862") has done so much to clear up the confused synonymy of the group, makes no reference to the fossil species. As he includes several forms, (such as the Californian *Pholas calva* of Sowerby) which have two oblique furrows on each valve, in Leach's genus *Martesia* as recently

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* "Cretaceous Pelecypoda of Southern India," page 24. † "Manual of the Mollusca," page 329.

‡ "Cretaceous Pelecypoda of Southern India," page 24.

§ "Proceedings of the Academy of Natural Sciences, Philadelphia, 1862," page 194.

restricted, and as the type of *Parapholas* has only one, the Queen Charlotte Island fossil is, for the present, regarded as a *Martesia*. It is not improbable that the two genera will ultimately be merged in one, and in that case *Martesia*, which is much the oldest name, will have to be retained.

Martesia tundens of Stoliczka, from the Cretaceous rocks of Southern India, in its young state nearly resembles the present species, but the Asiatic shell is more elongated and acute behind, and its valves are marked by only one impressed groove.

Thracia (Sp. undt.)

Compare Lutraria (Thracia ?) carinifera, Sowerby. "Mineral Conchology," Vol. VI., p. 66, Plate DXXXIV, fig. 2. (=Lyonsia (? Thracia) carinifera, (Sow.) D'Orbigny. "Paléontologie Française, Terrains Cretaces," Vol. III., page 385. Atlas, Plate CCCLXXIII., figs. 1 and 2.

A single imperfect cast, with the surface much abraded, which clearly belongs to the same genus as the fossil with which it has just been compared, and is very much like it specifically. Both are squarely truncate behind; in each there is an oblique ridge or keel which extends from the beaks to the posterior end of the base; and there is a certain resemblance in the general outline of both. Still, the two species are entirely distinct; the beaks in Mr. Richardson's specimen are divergent and wide apart, they are placed also at a considerable distance behind the middle, and consequently the shell is produced anteriorly and very short posteriorly. In *Thracia carinifera* the beaks are close together and nearly central, while the length of the shell is greater in proportion to its height than is the case with the species from the North Pacific. The only specimen of the latter is too imperfectly preserved either to permit of a sufficiently accurate description being made, or for a satisfactory comparison with closely allied forms.

Agassiz places Sowerby's *Lutraria carinifera* in the genus *Corimya*, but Stoliczka, who favours keeping *Corimya* and *Thracia* apart, thinks that it may be a *Thracia*, although he previously states that "fossil species belonging to *Thracia* proper are as yet only known from Tertiary deposits; those from Cretaceous beds may, with equal probability, be referred to the former genus" (*Corimya*). Pictet states more positively that it is a Thracia.

Thracia, (Sp. undt.)

Perhaps Corimya (? Thracia) Nicoleti, Agassiz. "Etudes critiques sur les Myes Fossiles." Livraison IV., page 272. Plate XXXVII, figures 1-6.

Compare also Corimya Studeri Ag. (=Tellina incerta, Thurm.)

Three broken and distorted casts of a typical species of Corimya (or Thracia) whose shape and surface markings are undistinguishable from those of the *Corimya Nicoleti* figured in the memoir above cited. In the most perfect of these specimens there are two narrow grooves on the right valve, which run obliquely from the hinge margin, behind the beaks, towards the upper part of the posterior end, but which are nearly parallel to the superior border behind. These of course indicate the presence of as many raised lines on the inner surface of that valve. Similar markings on the interior of the valves are not shewn quite so distinctly in the original illustrations of *C. Nicoleti*, nor is anything said about them in the text. Still, Mr. Richardson's specimens agree in every essential point with the description of that species, but they are so imperfect that their identification is uncertain and must be so until a better series is obtained. Goldfuss' figures of *Corimya Studeri*, under the name *Tellina incerta*, Thurman, are also very like the Queen Charlotte Island shell.

Most palæontologists have agreed in uniting Agassiz's genus *Corimya* with *Thracia* of Blainville, although this view was opposed by the late Dr. Stoliczka. If the two genera are to be kept separate, the present species, with its compressed rather than inflated form, and especially in its having "two long ribs running from the beaks posteriorly," belongs rather to *Corimya* as re-defined by Stoliczka, than to *Thracia* proper.

Pleuromya (?) Carlottensis. (N. Sp.)

Plate IX, Figure 8.

Shell slightly inequivalved, moderately convex in front, concavely attenuate at the sides behind. Outline elliptic ovate, short and narrowly rounded in front, produced and bluntly pointed at the base, posteriorly; length rather more than a third greater than the height.

The beaks are situated at a distance of about one-fourth from the anterior end; they are wide, but not very acute; their apices are curved inwards and a little forwards. Behind the umbones the hinge line is nearly straight but somewhat concave, its general direction is downwards. The ligamental area is lanceolate in outline, but not very clearly defined,

although there is a faint angularity which extends from the beaks to the posterior end of the hinge margin. The posterior end is broken but it seems to have descended in a gently convex, oblique curve to the ventral margin, which is very broadly rounded. In front of the beaks, but below them, there is a concave, but not very deeply excavated or definitely margined, lunular area; the anterior extremity is narrowly rounded, but slightly angular below.

Surface strongly and concentrically ribbed; the ribs rather obtuse and separated by deep, concave grooves.

Greatest length of the shell, one inch and eight lines; height, one inch one line and a half; maximum width or thickness, not quite eight lines.

The only specimen is a somewhat distorted cast, which is imperfect at the posterior end.

The shell is provisionally included in Agassiz's genus *Pleuromya*, as restricted or re-defined by Terquem, on account of its general shape and strong concentric costation; although it may be a *Panopæa*. Morris and Lycett, in their monograph of the Great Oolite Mollusca, and other writers who have accepted their conclusions, have reunited *Pleuromya* with *Myacites* of Schlotheim, and group the latter genus in the Anatinidæ. Stoliczka considers the former part of this hypothesis to be an "inadmissible generalization of characters," and believes that Terquem has sufficiently proved the distinctness of Agassiz's genus *Pleuromya*. Pictet in his "Traité de Paléontologie," (Vol. III., p. 360) goes still further than Morris and Lycett, and unites *Myopsis*, (Agassiz), *Pleuromya*, (Agasssiz). *Homomya*, (Agassiz), and some other genera, with *Panopæa*; he also places the latter genus (with *Pholadomya*) in his family Myacidæ.

Admitting, for the present, that *Pleuromya* may be a good genus, it seems to be capable of division into two well-marked sections. In the first, the beaks are placed very far forwards, and the surface is strongly costate; in the second, the umbones are situated near the middle, and the valves are only striated concentrically. *Pleuromya Carlottensis* probably belongs to the first of these divisions, which contains some species which have been referred to *Gresslya*.

The whole of the Mesozoic Anatinidæ or Myacidæ, (for the same genera have been placed in both families by different writers), are very imperfectly understood, nor is this circumstance to be wondered at. Although abundant in and eminently characteristic of the rocks of that epoch, the specimens usually met with are little more than badly preserved casts, from which the whole of the thin test has been removed. The microscopical characters of the shell, the nature of the hinge teeth and of the muscular

impressions can rarely be ascertained, or even the true surface markings. As the whole of the above remarks apply with full force to the present fossil, it may be easily imagined that its generic position is doubtful. Further, the only specimen yet collected has had its original shape so much altered by compression that the specific description may have to be materially modified or altered, when better examples have been obtained.

Pholadomya ovuloides. (N. Sp.)

Plate IX, figure 9.

Shell swollen and ventricose in front, rapidly decreasing in thickness behind; height more than one-third less than the length; outline sub-ovate. The superior border is straight and nearly horizontal, if viewed laterally, but as seen from above it is concavely inflected on each side, and the result is that there is a well-defined, narrowly lanceolate, excavated escutcheon. The inflection is so decided as to present the appearance of an obtuse ridge on each valve, and both of these extend in a slightly convex curve from behind the umbones to the posterior end of the hinge line, which is sunk below their level. The umbonal region is much inflated, but the beaks themselves are not very large, and do not project much above the hinge margin; they are situated very near the anterior extremity, but are not quite terminal; their apices are incurved, approximating, and point very slightly forwards. In front of, but just under the beaks, the hinge line is short, straight, and oblique, with a distinctly downward slope; there is no lunule. The anterior prolongation of the hinge line is mostly concealed by the upward swell of the beaks, so that in some aspects there appears to be a concave lunular declivity. The anterior end is angular a little above the middle, subtruncate in the centre, and somewhat rounded at the base. The basal margin is regularly semi-ovate (that is, on the supposition that the ovoid be divided in the direction of its greatest length) the most prominent part being about or behind the middle, the upward trend being greatest posteriorly. The posterior end is narrowly rounded, and judging by the lines of growth, a little angular at is junction with the hinge border above. In front and below, the valves seem to have been nearly closed; behind they gape very slightly.

The surface is marked by concentric ribs or rib-like folds, which are separated by narrow grooves. Both are very irregular in their disposition, and are often partly divided longitudinally, so that they are rarely continuous from end to end. There are also a few, very faint, radiating

lines, about twelve in number, which cross the concentric ribs, but which do not give a nodular appearance to the sculpture. These radiating striæ can only be seen in a rather strong light; they are most conspicuous on the upper surface of the valves, and become obsolete near the base, also at the anterior end.

As the above description was made from a mere cast, it is probable that the sculpture of the test was much more decided than it is in the only specimen now accessible.

Greatest length, about nineteen lines; maximum height nearly twelve lines; extreme width or thickness, eleven lines.

This fossil belongs to the second of Agassiz's divisons of the genus, the "Pholadomyes avec un Aire Cardinale Circonscrite,"* also to the fifth section of that group, the "Pholadomyes Ovalaires."†

Among European forms its analogies are with such species as *P. modiolaris*‡ and *P. ovulum*§ of Agassiz, particularly with the latter. In the first, a broad groove traverses the valves obliquely near the anterior end, and this is not present in *P. ovuloides;* in the second, the hinge line is not produced much beyond the umbones in front, nor is the anterior margin angular above; the opposite being the case in specimens of *P. ovuloides.*

In the Cretaceous rocks of North America there are several species of *Pholadomya*, which bear a considerable resemblance to *P. ovuloides*, and the *Pholadomya papyracea* of Meek and Hayden,|| from the Upper Cretaceous of Chippeway Point near Fort Benton, on the Upper Missouri, in particular has a very similar shape, and almost exactly the same sculpture. Still, *P. papyracea* is a much more compressed shell than *P. ovuloides;* the anterior end of the former is not angular above; and the hinge margin of *P. papyracea* is "not inflected so as to form a defined false area." The inflection of the hinge margin of *P. ovuloides* is very decided, and this feature alone will serve to discriminate between the two species.

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* "Etudes Critiques sur les Mollusques Fossiles." Livraison II., page 103.

† Idem, page 113. ‡ Idem, page 123. Plate III. *a*, figs. 1—6.

§ Idem, page 119, Plate III., figs. 7—9. Plate III. *b*, figs. 1—6.

|| "Proceedings of the Academy of Natural Sciences, Philadelphia, 1862," page 28. Also, "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." By F. B. Meek, Washington: 1876. Page 217, Plate V., figs 4, *a*, *b*.

LUCINA. (Sp. undt.)

Plate IX., fig. 12.*

FIG. 6.

Compare *Lucina subundata*, Hall and Meek. "Memoirs of the American Academy of Arts and Sciences." Cambridge: 1856. Page 384, Plate I., figs. 6, *a*, *b*. Also, Meek's "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." Washington: 1876. Page 133, Plate XVII., figs. 2, *a*, *b*, *c*, *d*, *e*, *f*; especially 2, *f*.

Shell compressed, thin, sub-circular, but more or less angular; broad in front, narrow behind; length rather greater than the height. The beaks, which are placed a little on the posterior side of the middle, are not very small; they project distinctly above the highest level of the hinge line, and are directed forwards. There is no clearly defined lunule, and the escutcheon is merely a linear lanceolate groove, with obtuse margins, for the reception of the ligament. The superior border is broadly triangular; the anterior side is wide and somewhat squared, but the upper angle is slightly in advance of the lower, and the latter is the most rounded off of the two. The basal margin is gibbous in front, but abruptly contracted behind; the posterior side narrows rapidly both above and below; its extremity being squarely truncate.

The surface is so much worn that the only markings visible are a few faint concentric striæ of growth; the characters of the interior of the valves are unknown; the test is extremely thin.

Greatest length of the only specimen, nine lines; height, from the beaks to the base, about eight lines; maximum thickness, four lines.

The differences between this little shell and some examples of *L. subundata* are very slight. The posterior half of the large individual of the latter species, figured by Mr. Meek in the Report quoted above, (at Plate XVII., fig. 2, *f*,) almost exactly corresponds with that of the present fossil, but the shape of the anterior side of the two shells is

* As this figure does not convey a very accurate idea of the shape of the shell, a more correct outline is given in the woodcut.

somewhat different. In *L. subundata* the front half of the superior border is represented as nearly horizontal, and the anterior side as broadly rounded; whereas in the specimen now under consideration the hinge margin in front is oblique, and the anterior side sub-quadrate. Such a slight variation in outline can scarcely be regarded as of specific value, but the fossil just described is too imperfect to be satisfactorily identified.

Lucina. (?) (Sp. undt.)

Probably the adult state of the preceding.

Fig. 7.

Compare *Lucina occidentalis, var. ventricosa*, Meek and Hayden. "Proceedings of the Academy of Natural Sciences of Philadelphia, 1860," page 427, as *L. ventricosa.* Also, Meek's "Report on the Cretaceous and Tertiary Fossils of the Upper Missouri Country," &c., page 135, Plate XVII., figs. 3, *a*, *b*, *c*.

Shell compressed, suborbicular, not at all angular, broadly rounded in front, narrower behind; length rather greater than the height. Beaks small, sub-central or a little in advance of the middle, scarcely raised above the highest level of the hinge margin. Superior border slightly convex and sloping gently downwards posteriorly, more abruptly so towards the anterior end. Ventral margin gibbous in front, contracted behind; posterior extremity narrowly rounded, or perhaps very bluntly pointed about the middle, but apparently not at all truncate.

The sculpture seems to consist of fine and closely arranged concentric striæ, but the surface is much worn. The dentition of the hinge and the other markings on the interior of the valves are unknown.

The specimen from which the above description was made is much broken at the anterior end, but, judging by the lines of growth, the dimensions are nearly as follows:—Estimated length, thirteen and a half lines; actual height, in the middle, twelve and a half lines; actual thickness, six lines.

Although it is almost certain that this shell is nothing more than the adult stage of the preceding species, it has been thought better to describe the two specimens separately. Both are broad in front and narrower behind; they agree, also, in other characters, such as the absence of a defined lunule, and the shape of the escutcheon. The only difference of any consequence is the position of the beaks, which are placed behind the centre in the small specimen, and a little in advance of it in the larger one. But Mr. Meek's figures of different specimens of *L. subundata* and *L. ventricosa* show that these two species vary in a precisely similar way. The same writer doubts whether *L. subundata*, *L. occidentalis* and *L. ventricosa* are more than varieties, or different stages of growth, of one species, and it certainly seems probable that such may be the case. The larger of the two *Lucinæ* from the Queen Charlotte Islands has almost exactly the shape of one of the specimens of *L. ventricosa* as represented by Meek, (Report cited, Plate XVII., fig. 3, *b*, *bis*.,) except that the beaks of the latter are placed behind the centre, and that its posterior end is sub-truncate.

Callista (?) subtrigona. (N. sp.)

Plate IX., fig. 10.

Shell moderately compressed, ovately triangular, bluntly pointed or subangular about the middle in front, and a little below it behind; length rather greater than the height; test very thin.

The beaks, which are placed at about one-fourth of the distance from the anterior end, are of medium size; their apices are directed forwards, and sunk a little below the highest level of the hinge line. There is no lunule, and the escutcheon is a narrowly lanceolate groove with almost vertical sides. The posterior half of the shell is somewhat produced and sub-angular below the middle; the superior border behind and the margin of the posterior end are united in one bold and unbroken convex curve, which extends from the beaks to the ventral margin. The downward direction of this curve is, however, most decided below the termination of the hinge line. The basal margin is broadly but unevenly rounded, the front half being most projecting and the hinder half rather more contracted. Below the beaks, in front, the superior border descends obliquely in a straight or slightly convex line, and forms a sub-angular junction with the ventral border at the centre of the anterior end.

The external sculpture consists of very fine and close set concentric striæ. The markings on the interior can only be traced, and that very obscurely, on the right valve of one of the casts. In this valve there are indications of three cardinal teeth, which diverge widely from above downwards. The anterior tooth is oblique and almost longitudinal; the centre one is short, triangular, and nearly transverse to the hinge line; while the posterior tooth is long, oblique and directed backwards. The pallial impressions seem altogether obliterated.

In an average specimen, the length is rather more than fifteen lines; the height, in the centre, is thirteen lines; and the thickness through the valves, six lines.

Nine or ten specimens were obtained by Mr. Richardson, three of which are quite perfect, with the shell preserved on both valves. The outline of the species is very variable, some specimens being nearly ovate while others are subtrigonal. *C. subtrigona* is a flatter shell with a more triangular form than *C. Deweyi* of Meek and Hayden,* and *C. orbiculata* of Hall and Meek † has the posterior side more broadly and evenly rounded. The figure on Plate VIII. represents a variety in which the anterior and posterior ends are not nearly so much pointed as usual.

Callista. (?) (Sp. undt.)

Plate IX., fig. 11.

Shell compressed, but rather tumid in the middle; very inequilateral; outline elongate ovate; length about a fourth greater than the height; test very thin. The beaks are situated very near to the anterior end, but are not quite terminal; they are small and point forwards, but their apices do not rise above the highest level of the hinge border. There seems to be no lunule proper, and the escutcheon is a narrowly lanceolate deep groove, which is bounded on each side by a sharp ridge. Behind the beaks the hinge line is almost straight, and its downward curve is very gentle; the posterior end is narrowly, and the basal margin broadly rounded. Immediately below the beaks, in front, a short and concave lunular declivity extends to a little above the middle of the

* "Proceedings of the Academy of Natural Sciences of Philadelphia, 1856," page 83. "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." By F. B. Meek. Washington: 1876. Pages 182-3, Plate XVII., figs. 15, *a*, *b*, *c*, *d*, *e*.

† "Memoirs of the American Academy of Arts and Sciences, Cambridge." Vol. V New Series. Pages 382-3, Plate I., fig. 7. "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," &c., pages 186-7, Plate V., figs. 2, *a*, *b*, *c*.

anterior end, beneath which the latter is narrowly rounded. The beaks being nearly terminal, the anterior portion of the shell is very short, and the posterior much elongated. Apart from the irregularity caused by the beaks, the general outline is almost that of a pure ovoid, the height being rather greater in front than behind.

The surface is marked by rather coarse and unequal concentric striæ of growth, but the sculpture is much eroded. Judging by the impressions on a broken cast, the hinge teeth seem to have been of the same number and shape as those of the preceding species.

Length of the most perfect specimen, one inch; height, in the middle, nine lines; maximum thickness, five and a half lines.

A single example, with the test imperfectly preserved on one valve, and a fragment of the cast of another.

This little shell appears to have some distant analogies with the *Callista tenuis* of Hall and Meek,* and with the *Venus sublævis* of Sowerby,† but the generic position of the present fossil is so uncertain that it would be a waste of time to speculate upon its specific relations with such imperfect materials at hand for comparison. It is just as likely to be a *Tapes* or an oval *Cyprimeria* as a *Callista*.

Besides the two *Callistæ* just described, there are a few large casts in a very poor state of preservation. Judging only by external form, some of these at least may have belonged to the Veneridæ, although no indications of the pallial sinus characteristic of that family as opposed to the Glossidæ, can be traced in any of them. The most perfect specimen, which measures two and a half inches in length by two inches in height, has much the general shape of *Cyprina ovata* of Meek and Hayden,‡ but that species has a less swollen umbonal region, and its test is comparatively thick. That of the Queen Charlotte Island shell is extremely thin and fragile.

Unio Hubbardi, Gabb.

Plate IX, figure 13.

Unio Hubbardi, Gabb. "Palæontology of California," Vol. II, pages 190-91, Plate XXX., fig. 85.

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* "Memoirs of the American Academy of Arts and Sciences, Cambridge," Vol. V. New Series, Plate I., fig. 5. "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," &c., page 188, Plate V., figs. 1, *a* to *d*.

† "Transactions of the Geological Society of London." Series IV. Vol. II., page 342, Plate XVII., fig. 5.

‡ "Proceedings of the Academy of Natural Sciences, Philadelphia, 1857," page 144. "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," &c., page 146. Wood-cut especially.

Perhaps = *Unio Aduncus*, Sowerby. "Mineral Conchology," Vol. VI., page 190, Plate DXCV., figs. 2, 2.

Shell convex, elongated; outline ovately triangular or ovately wedge shaped; anterior side short and rounded; posterior side long and bluntly pointed at the extremity; length greatly in excess of the height. Beaks moderately large, compressed at almost a right angle to the sides of the valves, incurved, pointing slightly forwards, and placed at a distance of about one-fourth the length from the anterior end. Lunule none; ventral margin straight, or a little concave behind the middle, more prominent under the beaks, and curving up regularly in front. Posterior side very variable in shape, usually moderately elongated and subtriangular, but sometimes much more lengthened and narrowly attenuate. In the typical form the hinge margin slopes convexly and rather rapidly downwards from behind the beaks, and the posterior extremity still more abruptly so, the latter being bluntly pointed below. The normal contour of this part of the shell is elongately subtriangular, two of the sides being gently convex and the central angle rounded.

In an exceptionally lengthened variety the posterior side is narrowly attenuated and wedge shaped; the hinge border descends obliquely in an almost unbroken straight line, and the posterior extremity is narrowly rounded.

A blunt ridge extends downwards and backwards from the beaks to the posterior end of the base, and in so doing separates an obliquely flattened area from the rest of the shell. The ligament is external and proportionately rather narrow.

The surface is marked by coarse and irregular lines of growth; the beaks, which are often much eroded, are undulately corrugated when perfect.

Out of thirty specimens collected by Mr. Richardson, twenty-nine have both valves, with the test, preserved, and the ligament even is visible in some. In every case, however, the posterior extremity, which is the thinnest and therefore weakest part of the shell, is broken off. Sometimes the surface of the test is partly covered by a thin film of pyrites.

The only detached valve collected, a right valve, having been soaked a long time in water, an attempt was made to remove the matrix thus softened and to expose the hinge teeth. Although the rather thick test broke in pieces during the operation, it was found that besides the ordinary cardinal teeth, there was a longitudinal groove in the right valve, for the reception of a corresponding lateral and laminar tooth in

the left. The shell, therefore, is clearly neither an *Anodonta* nor a *Margaritana*.

Estimated length of a fairly typical specimen, two inches and nine lines; actual height of do., from beaks to base, one inch and nine lines; maximum thickness, one inch and three lines.

Probable length of a much more elongated individual, three inches and one line; actual height from beaks to base, (the beaks being much eroded) one inch and eight lines; thickness, scarcely fifteen lines.

The shaded part of the figure on Plate IX. is intended as a representation of the elongated and attenuated variety of this species. In this instance the dotted lines are not added by way of restoration, but to show the shape of another individual. The majority of specimens are much shorter, and the downward slope of the anterior extremity is usually more decided. Mr. Gabb's partly restored drawing of the original type is slightly inaccurate; the hinge border behind is too straight and its downward inclination is not sufficiently expressed. The posterior end is too wide and its upper margin not convex enough.

The locality from which *Unio Hubbardi* was first obtained is thus described by the author of the species: "A single specimen, from the Nanaimo Coal Mine, Vancouver Island, Chico Group, kindly loaned me by Mr. Hubbard, of the Pacific Mail Steamship Company of San Francisco, and to whom I dedicate this species, in recognition of the unostentatious but valuable services he has been rendering to science for a series of years past." The statement that this fossil was found in the Cretaceous Coal fields of one of the Islands of the Vancouver group, is probably a mistake. At any rate it has not been recorded by any subsequent observer as occurring in that region, nor can any trace of it be found in the large and important collections made by Mr. Richardson at these islands during the past five years. On the other hand, it is not only one of the commonest species in the Carbonaceous Shales near Cowgitz on Graham Island, but it is the only mollusc yet detected in them.

The elongated and attenuated variety of *U. Hubbardi* described above, is barely distinguishable from the *Unio Aduncus* of Sowerby, a fossil from the Wealden Formation of Tilgate forest, in England. *U. Aduncus* seems to be rather straighter at the anterior margin, and its base is apparently rather more gibbous under the beaks than are the corresponding parts of the Queen Charlotte Island shell, but these differences do not appear to be constant, and in any case are scarcely of specific importance. The figures in the "Mineral Conchology" are taken from

broken examples, and the descriptions of the species are very short and indefinite.

The posterior pointed extremity of the English specimens are broken off, just as they are in the shells described above. In North America, as most collectors are aware, the pointed ends of the valves of living Unionidæ are often bitten off by muskrats and other animals, whose instinct teaches them which is the most fragile part of the shell and how best to get at the (to them) luscious morsel inside. In the case of the fossils, however, the fracture is probably accidental.

Trigonia diversicostata. (N. Sp.)

Plate X., figure 1.

Shell moderately inflated, elongated, scaphoid or subarcuate, very inequilateral; anterior end short and rounded; posterior side produced, cuspidate and bluntly pointed above. Beaks large, projecting, recurved, anterior, nearly terminal. Lunule none; posterior area (of the two united valves) broadly ovate lanceolate, with a rounded margin. Hinge border, behind the beaks, straight or slightly concave, sometimes with a very gentle downward inclination, which becomes a little more decided at the tip of the beaked posterior extremity. Ventral margin broadly rounded, but the upward curve is always greatest behind. The short anterior end is always much wider than the posterior extremity, and the margin of the latter is convex below and almost straight above. As measured in the centre, behind the beaks, the height is less than half the length: the thickness or convexity is nearly equal to the height.

Surface boldly ribbed, with a very singular and complex style of costation. At the anterior end the general direction of the ribs is almost horizontal, but near the margin they are curved, and ultimately straighten and trend upwards. In the basal half of the shell, however, they are either undulated or broken up into a series of zigzags. Thirteen or fourteen of these horizontal ribs commenced at the margin of the anterior end; then, near the middle of the valves, five or six of them suddenly bend upwards at a sharp angle, and become either transverse, or at length incline a little forwards. About one-half of the ribs which proceed from the anterior end are not continuous, but are distinctly truncated by the upward bend of those which reach to the superior border. This is most obvious in the umbonal region, for on the beaks the first five anterior ribs are cut off, as it were, by the upward bend of the sixth. Below this the anterior costæ seem alternately continuous and interrupted.

Towards the posterior end, the ribs are transverse and cross the valves in a radiating manner, the radii being directed backwards. At their junction with the outer border of the hinge area, these posterior costæ are narrow above and widen symmetrically to the margin below or behind.

The posterior area is ribbed longitudinally; but the costæ are curved and follow its general outline. At first they are very narrow, and attain their maximum width at the point farthest from the beaks. In some specimens the ribs which traverse the valves behind bifurcate with those on the posterior area, and at the extreme tip of the beaked end the direction of both is not far from parallel.

The sculpture of this distinctly characterized species is subject to considerable variation. In one specimen the transverse ribs which proceed from the anterior margin, are bent into a series of zigzags before they take their final upward turn. In another distorted example the same ribs traverse fully two-thirds of the shell before they bend upwards, and their angles lie in the direction of a line drawn obliquely from the beaks to the base of the posterior end. In the majority, the longitudinal and transverse ribs occupy each about one-half of the surface, and the angles of those which so suddenly alter their course are placed in the direction of an obliquely concave line which might be drawn from the beaks to a little behind the middle of the base. Again, in one instance the costæ on the posterior area bifurcate distinctly with the transverse ribs on the main body of the shell, in other examples the latter are truncated by the former. In all cases, however, the ribs in front, though they trend upwards, and their course is more or less broken, are nearly longitudinal; on the posterior area they are decidedly so, while on the beaked posterior end and on the hinder part of the umbonal region they are transversely radiating.

Greatest length of the specimen figured, twenty-one lines; height in the centre, behind the beaks, nine and a half lines; thickness, nine lines.

Seven specimens were collected, some of which are a good deal distorted.

A curious little *Trigonia* of the Scaphoid group, easily recognized by its very peculiar sculpture. The only species with which it might be confounded is the *Trigonia Vau* of Sharpe * from Secondary and probably Jurassic rocks in South Africa. The shape of these two

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* "Transactions of the Geological Society of London." Second Series. Vol. VII., page 194, Plate XXII., fig. 5.

fossils is almost identical, but the sculpture of each is very distinct. In *Trigonia Vau*, the ribs at the anterior end incline obliquely downwards before they change their course; in *T. diversicostata* their general direction is either longitudinal or upwards, but the most striking difference is in the markings on the posterior area of the two shells. In *T. diversi costata* that region is boldly and longitudinally ribbed; in *T. Vau* it is transversely striated and "divided into two parts by a slight longitudinal ridge."

Trigonia. (Sp. undt.)

Plate X., figure 2, 2*a*.

Shell compressed, elongate, subtrapeziform, narrowest behind; anterior end very short, posterior produced; length much greater than the height. Beaks small, anterior, subterminal, slightly recurved, not much elevated above the superior border. Lunule none; posterior area flattened laterally, with a rounded margin, made up of two elongately subtriangular spaces, one on each side of the hinge line; ligament external, short, thick, prominent and transversely striated. Hinge line straight, sloping gently downwards; posterior end obliquely subtruncate. Anterior end almost straight, but curved a little outwards; antero-ventral margin broadly rounded; base line convex in the middle, straighter, and curving much more gradually upwards behind.

Out of nine specimens on which the test is partly preserved and a number of imperfect casts, none shew the true characters of the whole of the surface ornamentation. The original of fig. 2, on Plate X., gives the clearest idea of the normal shape of the shell, besides showing the sculpture of the beaks and posterior area. Fig. 2*a*, on the same Plate, is a representation of the most perfect of four distorted individuals which have been compressed laterally, and whose exterior is either worn, exfoliated, or partly covered by the tenacious matrix. The only information afforded as to the sculpture of the main body of the shell, is that supplied by the four last mentioned examples. In these there appear to be about thirteen or fourteen obliquely transverse, concavely, curved rows of separate raised tubercles. The whole of the rows commence at the outer edge of the posterior area, and they all run obliquely downwards and forwards. Rather more than half terminate at the anterior margin, but just before reaching it they each turn abruptly upwards. The upward bend at the front margin consists only of a change of direction of the last tubercle, and there is a solitary intervening one, at

this end, between each of the two rows. The rest of the rows curve obliquely from the posterior area to the ventral border. One specimen shews very coarse and concentric raised striæ of growth, with corresponding grooves; also that the tubercles are longitudinally elongated. It is possible, indeed, that instead of rows of distinct and separate tubercles, the true sculpture may have consisted of oblique ribs which are interrupted and made tubercular by their being crossed by the concentric grooves just described.

The posterior area is transversely striated, and in one individual there is a faint longitudinal groove, bordered by an obtuse ridge, which runs the greater part of the length of its outer margin. Occasionally there are a few scattered tubercles in this region, but these are often absent, and when present are generally, though not always, most numerous near the beaks.

As none of the specimens are perfect or undistorted, it is not possible to give sufficiently exact measurements.

In 1873 Mr. Richardson collected a solitary specimen of a *Trigonia* at North West Bay, Vancouver Island, in a very fair state of preservation, which, in the writer's judgment, is scarcely more than a variety of *Trigonia Tryoniana* of Gabb.* Judging by the examples described above, the differences between the Vancouver and Queen Charlotte Island shells seem slight, but the resemblance may be more apparent than real, and may be mainly due to a want of knowledge of the distinctive sculpture of the latter.

The general shape, and the surface markings on the posterior area, are essentially the same in both. In the Vancouver fossil the central part of the valves is traversed by fifteen or sixteen oblique ribs, which commence at the outer limit of the posterior area. Nine of these terminate at the anterior margin and six cross to the ventral border, and the ribs increase more and more in their distance from each other towards the posterior extremity. The costæ are crossed by concentric and coarse grooves which give a subtubercular aspect to the ribs; in the umbonal region the tubercles are entirely distinct and separate. The upward bend of the tubercles just before reaching the anterior margin, and the occurrence of a single isolated one alternating at that end with each continuous series, two features which seem to be characteristic of the Queen Charlotte Island specimens, cannot be traced in the *Trigonia* from Vancouver. These are the only differences of any consequence that can be observed

* "Palæontology of California," Vol. I, pp. 188-9. Plate XXV., fig. 176.

between the specimens from the two localities; but, as has already been pointed out, the exact nature of the surface ornamentation of these from the islands in Skidegate Channel has yet to be ascertained.

Distorted examples, like that from which figure 2*a* on Plate X. was drawn, might be mistaken for the Oregon species doubtfully referred by Gabb * to the *T. Gibboniana* of Lea; but the normal shape of the two shells is quite distinct. The specimens described by Dr. Lea and Mr. Gabb clearly belong to the section Quadratæ, while the Queen Charlotte Island fossils would be more correctly placed among the Clavellatæ, which by some writers are united with the Scaphoidea.

Yoldia. (Sp. undt.)

Compare Yoldia nasuta, Gabb. "Palæontology of California," Vol. I., page 216, Plate XXXII., fig. 287, and Vol. II., pages 58 and 103.

Shell, or rather cast, compressed, moderately thin, elongated; beaks prominent, recurved, placed a little in front of the middle. Cardinal margin slightly convex, sloping gently downwards in advance; concave, and at length curving upwards behind. On the cast, a blunt ridge, which extends from the beaks to the tip of the posterior extremity, marks out a lanceolate, escutcheon-like depression, and a similar but more acute ridge in front, defines another area of the same shape, which represents the lunule. These appearances, however, are probably due to the thickening of the hinge plate on each side of the ligament for the reception of the teeth. Margin of the anterior end narrowly rounded or subangular about the middle; ventral border broadly rounded, but curving upwards more decidedly behind than in front; posterior end moderately produced, narrow and bluntly pointed above.

Surface marked with very fine and close set concentric striations, which are scarcely visible without a lens; hinge teeth numerous, not very small; pallial impression undistinguishable.

Greatest length of the only specimen, about three and-a-half lines; height, from beaks to base, rather more than two lines; thickness through the valves, not quite one line and-a-half.

A solitary cast of a probably immature individual, with a small portion of the test preserved on one of the valves.

The posterior end of the present fossil is narrower, and more pointed above, than is the corresponding part of *Yoldia nasuta*, and at present

* "Palæontology of California," Vol. I., page 190. Plate XXV., fig. 178, and Plate XXXI., fig. 262.

this is almost the only difference that can be detected between the two shells. At the same time only one example of each has yet been collected, so that there is not sufficient material for a critical comparison. *Y. nasuta* was originally described from "a single specimen in the collection of the Californian Academy of Sciences, labelled Los Angeles." In Vol. II. of the "Palæontology of California," Mr. Gabb makes the "unqualified statement" that the species is undoubtedly Tertiary," but expresses a doubt of the correctness of the locality on the label. If the writer of these pages is not misinformed, the Californian Academy has in its possession a collection of fossils from the same part of the Queen Charlotte Islands as that visited by Mr. Richardson, and there is a bare possibility that the two fossils may have been obtained from the same district. Mr. Gabb's assertions that the lithological characters of *Y. nasuta* "place it outside of all the known Cretaceous, and that its geological horizon is probably either Miocene or Post Pliocene, are, however, by no means in favour of this hypothesis.

Nucula. (Sp. undt.)

A cast of the right valve of a moderately convex, ovately triangular species of *Nucula*, with the anterior (and longer) side partly broken off. The impressions of the numerous anterior teeth are very clear and well defined, so that there is no doubt to what genus the shell belongs, but its specific peculiarities are entirely unknown.

Cucullæa (?) (Sp. undt.)

Two broken and water-worn casts of a large, elongated and very ventricose species of *Cucullæa* (?) with tumid and very prominent beaks, which are placed a little in front of the centre of the hinge line. It differs materially in shape from a shell which is abundant in the Cretaceous rocks of Vancouver and Sucia Islands, and which seems to be identical with the *Cucullæa truncata* of Gabb. The latter species, and perhaps both, scarcely belong to Lamarck's genus *Cucullæa*, as recently re-defined, but have more of the character of *Trigonoarca*, Conrad.

Modiola. (Sp. undt.)

Shell elongated, narrowly oblong, slightly curved; very ventricose, thickest in the direction of a line which might be drawn from the upper part of the beaks to the base of the posterior end. Superior border,

very gently arched or broadly rounded; basal margin concave in the middle and convex behind; anterior end obliquely subtruncate below the beaks, narrowest towards the base; posterior extremity ———? beaks terminal, obtuse. The test happens to be removed from the hinge area, and on the cast the superior border of both valves is obtusely carinate, each keel having a concave groove along its inner face. These carinæ and grooves extend the whole length of the hinge, and define an elongated, lanceolate, escutcheon-like depression.

Surface marked by close set, and regular, raised, concentric striations

Estimated length of the most perfect example, about three inches and two lines; actual height, in the middle, one inch and two lines; maximum convexity, one inch and four lines.

There are two specimens of this species, one of which has most of the thin test preserved on the left valve, though not on the right, while the beaks and a small piece of the posterior end are broken off. The other consists only of the anterior half of a cast of both valves, with a very small fragment of the test attached; but this specimen shows the shape and position of the beaks. The muscular and pallial impressions are not visible in either.

In *Modiola major* of Gabb,* the beaks are not terminal, and the surface is marked by coarse, distant and irregular lines of growth, but the general shape of that shell is otherwise very like that of the present fossil. Although probably new to science, the two mutilated specimens yet obtained are insufficient to show the full characters of the species. If the generic name *Volsella* of Scopoli is, as some writers assert, exactly synonymous with *Modiola*, Lamarck, the former name has long priority. The point being still somewhat doubtful, it has been thought best to retain a name sanctioned by long usage.

Aucella Mosquensis? Von Buch.

Plate X., figs. 3, 3*a*.

For the synonymy of European examples of this species, see Eichwald's "Lethæa Rossica," Vol. II., pp. 519, 520.

Probably = Aucella Piochii Gabb. "Palæontology of California," Vol. I., page 187, Plate XXV., fig. 173, and Vol. II., pages 194 and 247, Plate XXXII, figs. 92, *a. b. c.*

Shell moderately convex, obliquely obovate, narrowest in the umbonal region. Anterior side very short, somewhat truncated; posterior side

* "Palæontology of California," Vol. II., page 191 Plate XXXI., fig. 88

much longer, its margin rather narrowly rounded; base broadly rounded, most projecting in the middle, Hinge border, behind the beaks, almost straight and horizontal: hinge area flattened at a right angle to the sides of the valves, or a little concave. There is no defined escutcheon, although the beaks are subcarinate behind, in consequence of the distortion which the specimen has undergone. Ligament external, large and prominent, extending along most of the length of the hinge line. Beaks large, anterior, terminal, curved inwards and forwards. At the anterior end, immediately under the beaks, there is a deep inflection of the margin of each valve, and an ovately cordate sinus is thus formed by the junction of two sunken auricles, as represented at Plate X., fig. 3*a*. The inflection is probably of the nature of a byssal emargination, though no actual opening can be detected between the valves at this point. The inner faces of the sinus are perpendicular, and the auricles are flattened at a right angle to the sides of the shell. Surface of the test concentrically costate; the ribs rather fine, and narrower than the grooves between them.

Greatest length, about two inches; height, in the middle, one inch and nine lines; maximum convexity, eleven lines. The greatest diameter of the only specimen is in the direction of a line drawn obliquely from the beaks to the posterior end of the base. The shell is preserved on the whole of the right valve, and on part of the left. The sculpture is not very well shown, but there are no traces of any radiating striæ.

The above description is intended to apply exclusively to the curiously distorted fossil represented on Plate X. In this specimen, (the only one collected) the general direction of the compression appears to have been lateral, but also a little oblique, so that the valves have been partially displaced. The beak of the right valve, accordingly, projects somewhat beyond that of the left, and the left valve is quite as flat, if not flatter, than the right. It is scarcely necessary to add, that in the normal state the left valve is much the most convex of the two, and that its beak overhangs that of the right. The elongated shape of the sinus under the beaks, and the blunt ridges behind them, are also obviously due to the compression just described.

In 1875, Mr. G. M. Dawson collected about fifty or sixty well preserved casts of an *Aucella*, which is undoubtedly the *A. Piochii* of Gabb, at Tatlyaco Lake,* in British Columbia. A careful study of these

* Tatlyaco Lake is on the east branch of the Homathco River, which empties into Bute Inlet. In some maps it is spelt Tatlahco or Tatlayoco.

fossils has led to the following conclusions:—1st, that the distorted *Aucella* from the Queen Charlotte Islands, also belongs to Mr. Gabb's species, and secondly, that *Aucella Piochii* itself is most probably conspecific with the European *A. Mosquensis*, that is, if Eichwald's synonymy is to be trusted. The writer has not access to the volume of Leonhard and Browne's "Neues Yahrbuch," in which *A. Mosquensis* was first described, nor has he been able to see any European examples of the species; but some of Mr. Dawson's best specimens almost exactly correspond with the *Avicula Fischeriana*, as figured and characterized in the "Palæontology of Russia," which latter shell is admitted to be the same as *A. Mosquensis*.

According to Mr. Gabb, *Aucella Piochii* is "very characteristic of a series of shales of the Shasta Group, found from Mount Diablo, at various points along the east face of the Coast Range, to the north end of the Sacramento Valley. Two or three good specimens from Washington Territory, east of Puget Sound, were presented by Mr. Samuel Hubbard to the California Academy of Natural Sciences. In Colusa County, east of Clear Lake, I found this shell forming almost the entire bulk of some beds, interstratified with the white limestones." At Tatlyaco Lake the rock is also largely made up of casts of this species, apparently to the exclusion of every other fossil; in the Queen Charlotte Islands it seems very rare. In Mr. Richardson's 1872 collections from Vancouver Island, there are two specimens of *A. Piochii* labelled "from loose pieces near Victoria," and Mr. G. M. Dawson has recently found another example in a boulder on the same island.

Aucella Mosquensis has been recorded from many localities in the northern part of the Russian Empire, and, according to Nordenskiold,* it occurs also at Spitzbergen. It appears to have been a gregarious mollusk, and is often met with in considerable numbers. Eichwald states that on the margins of the River Jauza, in the city of Moscow, there are banks of shells composed almost entirely of this species. Its exact geological horizon has been the subject of much discussion, and is still doubtful. In the "Geology of Russia," (1845) D'Orbigny says that it is characteristic of the "ètage Oxfordien." Eichwald, in the "Bulletin de la Société Impériale des Naturalistes de Moscou for 1861 and 1862," and later in the "Lethea Rossica, 1867," Vol. II., page 520, places it in the Upper and Lower Neocomian. Writing in 1864 and

* "Sketch of the Geology of Spitzbergen." By A. E. Nordenskiold. Translated from the "Transactions of the Royal Swedish Academy of Sciences, Stockholm, 1867."

1865, Trautschold* claims that *A. Mosquensis* is a Jurassic fossil, possibly of the horizon of the Kimmeridge clay, though in a paper entitled "Die Schiedelinie Zwischen Jura und Kreide in Russland,"† dated 1875, the same writer is inclined to place it a little higher in the series, and to make it of about the age of the Portland Oolite. A conclusion similar to the one last cited had been arrived at by Rudolph Ludwig‡ in 1874, who expressed the opinion that one of the varieties of *A. Mosquensis* at least is a Tithonic form.

Eichwald§ thinks that *Aucella Pallassii* Keyserling, *A. concentrica* Fischer, *A. crassicollis* Keyserling and *A. Caucasia* Von Buch, are only varieties of *A. Mosquensis* based upon slight and unimportant differences in sculpture and external shape. The correctness of this opinion has not been disputed, but it is interesting to observe that while the surface of the test of the whole of these nominal species is concentrically striated, that of *A. Pallasii* and *A. Caucasia* is marked also with more or less distinct radiating lines.

In the "Proceedings of the Californian Academy of Sciences for 1864," Mr. Gabb described a fossil from the auriferous slates of the Sierra Nevada, on the Mariposa estate, as *Lima Erringtoni*. Mr. Meek‖ not only regards this shell as an *Aucella*, but says that it "is so nearly allied to the *A. Pallasii* of Keyserling," that he "would not be surprised if they should prove to be identical when direct comparisons can be made." The Californian shell has radiating as well as concentric striæ.

D'Orbigny and Eichwald have both noticed the remarkably close resemblance which exists between casts of *Aucella Mosquensis* and *Inoceramus concentricus*, and there is just the same similarity between American examples of the latter shell and *Aucella Piochii*. It happens that *Inoceramus concentricus* is rather abundant at the Queen Charlotte Islands, also, that the specimens are only well-preserved casts; and it is by no means easy to distinguish these from the *Aucellæ* from Tatlyaco Lake. On the right valve of the casts of the *Aucellæ* there is generally an oblique and deeply-channelled groove immediately under the beaks, caused by the sudden inflection of the valves at this point, and this is always absent in the Inocerami. Still, it is scarcely possible to discriminate between casts of very young examples of the two species.

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* "Zeitschrift der Deutschen Geologischen Gesellschaft, Berlin." Vol. XVI., pages 584—94, and Vol. XVII., pages 448—456.

† "Bulletin de la Société Impériale des Naturalistes de Moscou." Vol. XLVIII., page 150.

‡ Idem., Vol. XLVIII., pages 373-80.

§ "Lethea Rossica," Vol. II., page 523.

‖ "Geology of California," Vol. I., pages 479-80.

If the supposition that *Aucella Piochii* is merely a synonym of *A. Mosquensis* should prove to be well founded, the species has a very wide geographical distribution, and a somewhat extended range in time. *A. Erringtoni* may also be only another variety of this protean shell.

Meleagrina amygdaloidea, (N. Sp.)

Plate X., fig. 4.

Shell inequivalved, left valve moderately convex, the right slightly flatter; outline broadly elliptic-oval; height about one-third greater than the length. Beaks rather small, curved forwards and downwards, placed a little in advance of the centre of the valves. Escutcheon linear lanceolate, subcarinate at the margin, filled up, except at the extreme ends, by the thick ligament which projects above it in the centre. Hinge border wingless, convex near the beaks, then sloping obliquely and rapidly downwards. The posterior margin is broken, but it appears to have been straight, and it forms a subangular junction with the hinge line above. Anterior margin descending obliquely and widening outwards in a shallowly concave curve which extends from the beaks to a point opposite to the termination of the hinge line behind; very slightly convex in the middle. The base, together with a small portion of the lower part of the two sides, has almost exactly the shape of the widest end of a broad ovoid.

The surface of the test, which is very imperfectly preserved, appears to be marked with faint, distant and rather irregular concentric striæ, or plications.

Height, two inches and six lines; length, one inch and nine lines; thickness, allowing for a part of the shell which is wanting on one valve, one inch.

A single specimen, with the posterior margin broken, but which shows the large external ligament, and the test composed of an outer, fibro-prismatic layer, and an inner nacreous lining; a combination of characters almost peculiar to the Aviculinæ.

On the whole, this wingless Avicula is probably a rather aberrant species of the Lamarckian genus *Meleagrina*, but it may prove to be the type of a new sub-section. It is true that the shortness of the hinge suggests affinities with *Pseudoptera*, as recently re-defined by Meek,* but

* "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." Washington: 1876. Page 29.

the shape of the present shell is not so oblique, and its valves are not so decidedly unequal in convexity as in typical examples of that sub-genus.

M. amygdaloidea seems congeneric with a fossil from the Cretaceous rocks of Vancouver Island, described by Mr. Gabb* as *Meleagrina antiqua*. The differences between the two species are, however, tolerably clear. In *M. antiqua*, the height is not much greater than the length, the beaks are terminal, and the hinge line is straight and almost horizontal. In *M. amygdaloidea*, the height greatly exceeds the length, the beaks are sub-central, and the hinge margin is convex and very oblique.

Inoceramus concentricus, Parkinson.

Inoceramus concentricus, Sowerby. "Mineral Conchology," Vol. III., page 183, Plate CCCV.

Inoceramus concentricus, Goldfuss. "Petrefactæ Germanicæ," Vol. II., Plate CIX. figs. 8*a*—*c*, but *not d* and *e*.

Inoceramus concentricus, D'Orbigny. "Paléontologie Française, Terrains Cretaces," Vol. III., page 506, Plate CCCCIV.

Inoceramus concentricus, Pictet. "Traité de Paléontologie," Atlas, Plate LXXXII., fig. 18.

Twenty-five specimens of an Inoceramus, apparently referable to a single species, were collected by Mr. Richardson at three localities. Twelve are from the lower shales of Maud and Lina Islands; five from rocks of the same horizon on the shores of a small bay south of Christie Bay; and eight from the upper shales on Graham Island, about three miles to the north-east of the village of Cowgitz. They are the only fossils procured from the two last-mentioned localities, which are indicated on the map by the letter F.

Eight of the examples from Maud and Lina Islands are sufficiently perfect and undistorted to enable them to be identified with some certainty as the *Inoceramus concentricus* of European authors. Although nothing more than tolerably perfect casts, the obovate outline, the convexity of the left valve, with its prominent and semi-spiral beak, and the flatter and smaller right valve, so characteristic of *I. concentricus*, are very clearly shown. These undistorted fossils vary both in shape and sculpture; oblique specimens, which are regularly costate, might have served for the originals of Goldfuss' figures; while others, again, with a more nearly equilateral contour and irregular concentric striation, correspond better with the illustrations of D'Orbigny and Pictet.

* "Palæontology of California." Vol. II., page 192, Plate XXXI., fig. 89.

Four of the *Inocerami* from Maud and Lina Islands, and all from the other localities, are either so imperfect or so much crushed out of shape that it is impossible to determine satisfactorily to what species they belong; still, as stated above, it is most probable that they are all *I. concentricus*.

I. concentricus is abundant in the Cretaceous rocks of many localities in Europe. It is most characteristic of the Gault, but is found also in the Upper Greensand. It has not yet been recorded as occurring on the mainland of North America.

The species was first described by Parkinson in Vol. V. of the First Series of the "Transactions of the Geological Society of London, 1820," but a reference to the original description is purposely omitted above, because the writer has not had the opportunity of consulting it.

Melina mytiloides (?) (Lamarck. Sp.)

Perna mytiloides, (?) Lamarck. "Animaux sans Vertèbres." Second Edition. Vol. VII., page 79.

Perna mytiloides, (?) Damon. "Supplement to the Geology of Weymouth and the Island of Portland," Plate II., fig. 5.

Perna mytiloides, (?) Phillips. "Geology of Oxford and the Valley of the Thames," Plate XV., fig. 5.

Fig. 8.

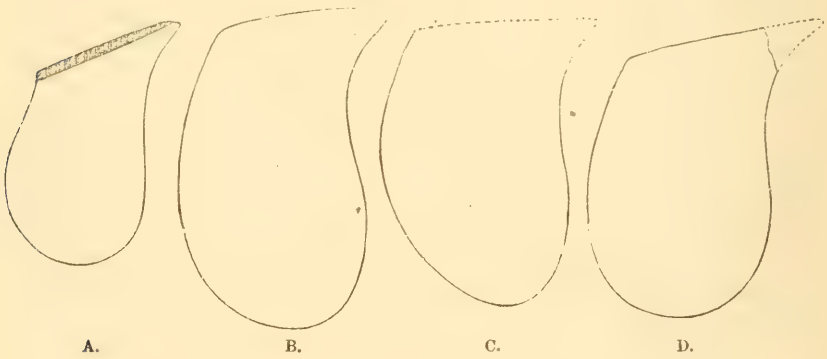

Fig. 8.—A, B, C, D.—Outlines of four specimens of *Melina mytiloides* (?), about one-third of the natural size. The original of fig. A, though little more than half grown, is the only one in which the hinge and beaks are perfect; in fig. C, the lower half of the shell is entire; the other two are partly restored from the lines of growth.

Shell nearly equivalved, compressed, thickest near the anterior margin; general outline elliptic-ovate, obliquely truncate above; height much

greater than the length. The shape varies in different individuals, and the variation of the contour can be best expressed by a separate description of each part.

The hinge line is usually straight and oblique, but the amount of obliquity is greater in some specimens than in others. In fig. A, the maximum of obliquity is reached; in figs. C and D, the hinge line is more nearly horizontal; and in fig. B, it was probably a little convex. There are between ten and twelve cartilage pits in the hinge, and these sometimes, though not always, are narrowest at the posterior end.

The beaks are slender, elongated and terminal; they are unequal in size and of a different shape, but both project considerably beyond the anterior margin. As viewed from above, the beak of the right valve curves decidedly outwards from the hinge line at a short distance from the apex, and then turns rather suddenly inwards and almost backwards. The beak of the left valve is straight, and points forwards, the extreme tip being bent slightly downwards. The anterior margin is usually shallowly concave from the beaks to about the middle, so that the two sides of the upper half of the shell are almost exactly parallel. In some specimens, the concavity of the margin in the region of the byssal opening does not quite extend to the middle. Beneath the centre the anterior border generally widens a little, and becomes gently convex, but occasionally it is almost straight. The front margin, as a whole, has the shape of a sigmoid curve, but this is sometimes almost straightened out. In some examples, the shell is as wide or wider below than above; in others it is narrowest below.

The byssal orifice is well shown in two or three instances. Below the beaks, in front, the edge of the left valve projects slightly beyond that of the right, and between both there is a long but very narrow opening.

The shape of the posterior margin is very variable in different specimens. In some it is almost straight and perpendicular; in others, it is rather oblique above the middle, and gradually widens and becomes decidedly convex below; but in every case it forms an angular junction with the hinge line above. The base is either evenly and narrowly rounded, or else it is produced and somewhat pointed in front of the middle.

The surface is marked apparently by irregular and, for the most part distant, concentric striæ, but the test is exfoliated in all but a single specimen, and on this there is only a small portion of the outer layer preserved.

Height of the largest example (fig. B), about five inches from hinge to base; approximate length of ditto, two inches and seven lines; thickness through the valves, one inch and four lines.

Ten specimens were collected, some of which are very imperfect.

It has been thought desirable to give figures and a description of these fossils, for although the writer has failed to find a single character by which they can be satisfactorily distinguished from the *Perna mytiloides* as figured by Mr. Damon and the late Professor Phillips, he is by no means convinced that they belong to that species. The Lamarckian definition of *P. mytiloides* ("P. testâ ovato-oblongâ, depressâ, basi acutâ; cardine obliquâ) is altogether insufficient for the discrimination of closely related forms.

The generic name *Melina* of Retzius has priority over *Perna*, Bruguiere.

Syncyclonema Meekiana. (N. sp.)

Fig. 9.

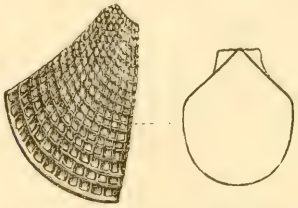

Fig. 9.—Syncyclonema Meekiana.—Outline of an immature but nearly perfect example, with a portion of the test of another specimen magnified to show the details of the sculpture The engraver has not made the tubercles which result from the crossing of the ribs sufficiently distinct.

Shell small, compressed, thin; subovate when half grown, but nearly orbicular when adult; often triangular above the middle. The ears are imperfect in all the specimens; but in the upper valve they appear to have been horizontal above and almost vertical at the sides; those of the lower valve are unknown.

The surface of the main body of the shell is marked by very numerous, fine and closely-arranged, rounded concentric ribs, which are crossed by exactly similar radiating costæ. The points at which the radiating ribs pass over the concentric ones are marked by small rounded elevations or tubercles, which give a nodose appearance to the sculpture, but which are too small to be visible to the naked eye. The wood-cut does not give a very good idea of these. Sculpture of the ears unknown.

Out of about twenty specimens of this little Pecten, only one shows the peculiar nodosely-cancellate sculpture which forms one of the best distinctive characters of the species; the rest are all exfoliated.

At first sight S. *Meekiana* might easily be confounded with the *Pecten Rogoznicensis* of Zittel,* but a closer comparison will show important differences in the sculpture of the two shells. In *P. Rogoznicensis* the relatively coarse radiating ribs cut through the finer and more delicate concentric costæ, and accordingly there are no tubercles or swellings at the point of contact.

The surface markings of *Pecten nodoso-cancellata* Eichwald, † as the name suggests, are still more like those of *S. Meekiana*, but the narrowly spathulate shape of the Russian shell will at once enable it to be recognized.

The species is dedicated to Mr. F. B. Meek, of Washington, one of the most industrious and accurate of American palæontologists, and the author of the sub-genus to which it belongs.

Ostræa. (Sp. undt.)

Three single valves of a species of *Ostræa*, two of which are so much exfoliated that they only show the general outline of the shell, which is what would generally be called long and narrow, but the elongation is in the direction of the height, which is nearly twice the length. Their contour, too, is irregular, being somewhat dilated below the middle. The third specimen is broadly sub-triangular, the narrowest part being near the beaks; the test is very thick. The characters of the three collectively, are rather like those of the *Ostræa Leymerii* of Deshayes, a French Upper Neocomian fossil.

BRACHIOPODA.

Terebratula (?) (Sp. undt.)

Shell subovate or suborbicular, usually a little pointed both above and below. In the adult the length is greater than the width, but in half-grown individuals the opposite is the case. Pedicelled or neural valve without any definite umbonal ridge, but convex in the middle, and

* "Die Fauna der Aelteren Cephalopoden Fuehrenden Tithonbildungen," page 241, Plate XXXVI., figs. 23, *a*, *b*.

† "Lethea Rossica," Vol. II., page 445. Atlas, Plate XX., figs. 11, *a*, *b*

obliquely compressed at the sides; brachial or hœmal valve much the flattest of the two. The beaks are partly broken in each specimen, but the foramen was undoubtedly large: the size and shape of the deltidium cannot be ascertained. Front of the valves almost straight, or, at any rate, not distinctly sinuous.

The test is exfoliated in every case, but there is clear evidence that the surface was marked with rather distant concentric striæ, and in one specimen at least with fine and close set radiating lines. The punctate character of the shell is also plainly visible with a lens. Length of the largest example, two inches and two lines; width, twenty-three lines; maximum convexity twelve and a half lines.

The species is represented by three broken and badly preserved specimens, which have very much the aspect of *T. depressa*, Lamarck, and *T. subdepressa*, Stoliczka, as represented in the "Palæontologia Indica,"* but they are too imperfect to be identified with much certainty.

Terebratula (?) (Sp. Undt.)

A small specimen of possibly another species of *Terebratula*, but in very bad condition, and partly buried in the matrix. It has a more convex hœmal valve than the shell last described, and a much smaller foramen.

ANTHOZOA.

The only coral collected is so much water worn that its generic position is doubtful.

ADDITIONS AND CORRECTIONS.

Nautilus, Sp. Undt. (Pages 14–19.)

The remarks under this heading were written in 1875, before the publication of the "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." In that very useful work, Mr. Meek expresses an opinion that the *Nautilus elegans* of Sharpe is probably identical with *N. elegans* of Sowerby, but that *N. elegans*, D'Orbigny, is perhaps distinct. With all due deference to Mr. Meek's judgment, the writer can scarcely see his way clear to accept the first of these conclusions. Sharpe's description and figures of *N. elegans* do not accord at all well with those of the type in the "Mineral Conchology," yet no reasons are given to account for a discrepancy which, it is thought, must have been obvious if the two forms had been compared directly.

* Vol. IV, pp 16, 17. Plate II., and Plate III., figs. 1–8.

The Sucia Island fossil agrees almost exactly with Meek's diagnosis of the American shell figured as *N. elegans*, but the former is rather the most compressed of the two.

ACTÆON, Sp. undt. (Page 53.)

Six specimens were described under this name, which probably belong to two species, perhaps even to different genera. Two of those have a narrowly cylindrical shape like that of *Actæon attenuata*, Meek, * the others a swollen body whorl and a very short spire, much as in *Pseudobuccinum Nebrascense*. † Another specimen of the short inflated form has recently been obtained by breaking up small pieces of rock from the Queen Charlotte Islands, and this has part of the test preserved. Under the microscope the sculpture is seen to consist of flattened revolving ribs, with nearly perpendicular sides, separated by grooves of nearly equal width, both of which are crossed by fine, transverse, raised striæ. *Ringuicula varia*, Gabb, ‡ from the Chico Group of Cow Creek, Shasta County, California, has exactly the same surface markings, but it has a more elongated spire than the present species, and has five or six whorls instead of three.

ERRATA.

Page 7, line 12 from the bottom. For "*rarely*," read "*barely*."
Page 21, line 7 from the bottom. For "*seem*," read "*seems*."
Page 24, line 6 from the top. For "*Plate III*,, *fig.* 3," read "*Plate III.*, *fig.* 1."

* "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," page 281. Plate XIX., figs. 17, *a. b.*

† Idem, page 350. Plate XXXI., figs. 5, *a, b, c, d.*

‡ "Palæontology of California," Vol. I., page 112. Plate XXIX., figs. 222, *a. b.*

CONCLUSION.

In Europe, where the succession of the Mesozoic rocks has been traced out in more minute detail than in North America, and where the animal life of the age is better known, it is found that its marine fauna is continuous throughout, with only local exceptions. The Rhætic beds hold fossils which pass from the Trias into the Lias, and M. Ernest Favre has shown that the Jurassic and Cretaceous strata of the Alps are not separated, as in the Anglo-Parisian basin, by fresh water deposits. In 1865, Prof. Oppel, of Munich, proposed the name of the Tithonic Group for certain rocks which occur in Spain, Italy, Switzerland, Austria, &c., and which were then believed to be the equivalents of the Portland Oolite and Purbeck beds of England. Still later, Dr. Neumayr has suggested the division of this group into an Upper and a Lower series. It is by no means certain that the Upper Tithonic strata are exactly synchronous with the English Purbecks, but it is tolerably clear that the former represent the extreme top of the Jurassic Series as understood by European geologists. The Upper Tithonic deposits are beds of passage between the Jurassic and Cretaceous, and contain a small percentage of marine fossils which pass upwards into the Lower Neocomian. *Aucella Erringtoni*, from the auriferous and presumably Jurassic slates of the Sierra Nevada, may be identical with the *A. Piochii* of the Shasta Group of California, but, with this exception, no fossil is known to be common to the Jurassic and Cretaceous formations in America.

A different classification of the Cretaceous rocks is adopted in two of the most popular and recent hand-books of geology. Professors Jukes and Geikie* recognize only an Upper and a Lower Cretaceous group, and place the Wealden at the base of the latter. In the second edition of Prof. Dana's "Manual of Geology," dated 1874, the period is divided into Upper, Middle and Lower Cretaceous, while the Wealden is regarded as a separate epoch, belonging to the upper part of the Jurassic. As Prof. Dana's manual is universally used in America, it will be more convenient to adopt his arrangement.

* "The Student's Manual of Geology." By J. Beete Jukes, M.A., F.R.S. Third Edition. Edited by Archibald Geikie, F.R.S. Edinburgh: 1872.

It should be premised, also, that an opinion is gaining ground that sedimentary deposits which contain fossils of exclusively land or fresh water origin, such as the Purbecks and Wealden, should be tabulated in a separate series from the purely marine strata, and not intercalated between them.*

The collection obtained by Mr. Richardson is remarkable for the almost total absence of those genera which are restricted to a single epoch, and the fossils for the most part are strikingly unlike those of any known division of the Mesozoic age in America.

The following is a synoptical list of the species, arranged in zoological order:—

	Total No. of Species.	Unrecognizable.	New.	Previously described.
Cephalopoda	14	3	8	3
Gasteropoda	6	4	2	0
Lamellibranchiata ...	22	12	7	3
Brachiopoda	2	2	0	0
Anthozoa	1	1	0	0
	45	22	17	6

Including the shells referred doubtfully to *Scalaria Albensis* and *Melina mytiloides*, twenty-two of the above are represented by such imperfect specimens that the species, and in some cases even the genera, cannot be determined with any precision. A few are probably new to science, but they are not in a satisfactory condition for description. Of the remainder, seventeen are now described and figured for the first time, while six belong to forms which have been named and characterized by other writers.

It has already been stated that these invertebrates present "an apparent mixture of Oolitic and Cretaceous types," and this opinion is based upon the following facts:—

Five of the new species, and three of the doubtful forms, bear a suggestive, but, at the same time, only a very general resemblance to European Oolitic fossils, which may be thus expressed:

* See Prof. J. Young's Address before the Geological Section of the British Association for the Advancement of Science, at Glasgow, 1876.

Queen Charlotte Islands.	Analogies to European types.
Ammonites Richardsonii	Nearly related to A. coronatus, Brug. from the "Callovien" of France.
A.Skidegatensis & A.Carlottensis	Of the type of Perisphinctes tyrannus Neumayr and allied to several of the Oolitic Planulati.
A. Loganianus forms A. & B. ...	More like the Oolitic than the Cretaceous Macrocephali.
Pseudomelania (?) Sp. Undt....	Scarcely to be distinguished from P. Heddingtonensis.
Actæonina (?) Sp. Undt.....	A genus most characteristic of the Oolitic epoch.
Pleuromya Carlottensis.....	The ribbed Pleuromyæ do not appear to range upwards into the Cretaceous, but this shell may be a Panopœa.
Melina mytiloides? Lam. Sp. ..	Very doubtfully referred to this Tithonic and Middle Oolite species. Quite likely both distinct and new.

Further, a comparison of Mr. Richardson's collection with the fossils of the Tithonic formation of the Carpathians, Southern Alps and Central Apennines, as monographed by Zittel, reveals other, and perhaps closer correspondences, such as the following :—

Queen Charlotte Islands.	European Tithonic.
Nautilus, Sp. Undt.....	Nautilus asper, Oppel.
Ammonites Perezianus	Oppelia Waageni, Zittel.
" Richardsonii.....	Ammonites Groteanus, Oppel.
" filicinctus	Lytoceras quadrisulcatum, D'Orb.
" crenocostatus	" Liebigi, Oppel.
" Sp. (Nr. A. simplus D'Orb.)...	Aspidoceras cyclotum, Oppel, young.
Syncyclonema Meekiana.....	Pecten Rogoznicensis, Zittel.

Aucella Piochii, Gabb, is probably the same as the *Aucella Mosquensis* of Von Buch, and the latter shell is either of Middle or Upper Oolitic age in Europe, but in America *A. Piochii* is said to be one of the most characteristic Lower Cretaceous fossils.

On the other hand, what little direct and positive evidence is at present afforded by the fossils from the Queen Charlotte Islands is in favour of their being referred to the Cretaceous period. Six of the species from this region, whose names are given below, have been previously described from other localities and by different writers.

The whole of these are Cretaceous, unless, indeed, some of the members of the Shasta Group should prove to be of Upper Tithonic age, which is by no means improbable.

Queen Charlotte Islands.	Original Localities and Horizons.
Ammonites Timotheanus, Mayor.....	Gault of Switzerland.
Inoceramus concentricus, Parkinson.....	Gault of England.
Ammonites Brewerii, Gabb.....	Shasta Group of California.
" Stoliczkanus, Gabb.....	" " "
Aucella Piochii, Gabb (?= A. Mosquensis).	" " "
Unio Hubbardi, Gabb	Chico Group of Vancouver Island. (Probably an error.)

The remainder belong, in many cases, to genera which originated in the earlier part of the Mesozoic age, and which are not yet extinct.

Mr. Gabb has divided the Cretaceous rocks of the west coast of America into the Shasta, Chico, Martinez and Tejon Groups, but the Martinez is now regarded as only a subdivision of the Chico Group. The "Shasta Group" is the oldest known member of the formation, the name being originally suggested for a series of beds which the same author believes to be the "equivalent, or at least the nearest representative of the Neocomian."* Next in order comes the "Chico Group," an accumulation of sediments of immense thickness, "which includes all of the known Cretaceous of Oregon, and of the extreme northern portion of California," † also the Coal-bearing formation of Vancouver Island. According to Dana,‡ the so-called "Martinez Group" of Mount Diablo, forms its uppermost subdivision. Lastly, the newest member of all is the "Tejon Group," which is supposed to correspond to the Maestricht beds of Europe, but which has not yet been recognized outside of California. Nearly the whole mass of the Cretaceous formation of the Pacific slopes is made up of the Shasta and Chico Groups, and Mr. Richardson estimates the thickness of the Vancouver Island deposits, which are believed to belong to the latter of these two divisions, at 5,000 feet.

* "Palæontology of California," Vol. II. Foot note to page 129.

† Idem. Preface, page xiv.

‡ "Manual of Geology." Second Edition. Page 457.

As three species of fossils are common to the Queen Charlotte Islands and to the "Shasta Group" of California, it will be curious to note whether there are any other points of resemblance between the known faunæ of the two localities. An analysis of the fossils of the Shasta Group, as catalogued in Vol. II. of the "Palæontology of California," gives the following results:—Crustacea, one species; Cephalopoda, nineteen; Gasteropoda, fifteen; Lamellibranchiata, eleven; Brachiopoda, one. The proportion of Cephalopoda to Gasteropoda in the Queen Charlotte Island collection is as fourteen to six, and there are no exclusively Cretaceous genera in any of the three classes of mollusca. In the Shasta beds there are nineteen species of Cephalopoda to fifteen of Gasteropoda, and the only exclusively Cretaceous genera or sub-genera are *Crioceras*, *Anisomyon*, *Thetis* and *Neithea*.*

The writer happens to have exceptionally favourable opportunities for a comparison between the invertebrata of the Coal-bearing rocks of the Vancouver and Queen Charlotte groups. For the past five years, from 1871 to 1875 inclusive, Mr. Richardson has been engaged in a critical examination of the geology of the Nanaimo and Comox districts of Vancouver, together with that of many of the smaller islands of the Strait of Georgia. One of the results of his labours in this region has been the collection of an extensive and interesting series of fossils, consisting of about seventy or eighty species of mollusca proper, two of brachiopoda one cyclostomatous polyzoon, and a turbinolian coral. These have only been partly studied so far, but twenty-nine of the shells are identical with as many species which have been already described from these islands by Meek, Shumard and Gabb: about fifteen more are also conspecific with fossils either of the Chico Group of California or else of the Upper Cretaceous of Texas or New Jersey: the rest appear to be new. So far as the number of genera and species are concerned, Gasteropoda decidedly predominate over Cephalopoda in the Vancouver Cretaceous, and the same thing holds true with regard to rocks of the same age in other localities. Thus, in Mr. Gabb's catalogue of the fossils of the Chico Group from Oregon and California, † there are as many as forty-eight species of Gasteropoda to fifteen of Cephalapoda. In the Vancouver rocks each of the three divisions of the mollusca is represented by very characteristic Cretaceous genera, as in the following list:—

Cephalopoda. Baculites, Hamites, Heteroceras or Helicoceras.

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* According to Stoliczka, *Vola* is an older name than either *Neithea* or *Janira*,

† "Palæontology of California," Vol. II., pp. 208—254.

Gasteropoda. Stomatia, Cinulia, Fulgoraria, Pleurotoma.

Lamellibranchiata. Axinæa, Acila, Conchocele, Thetis, and many kinds of Inoceramus.

The marine faunæ of the coal-bearing series of the Vancouver and Queen Charlotte Islands appear, therefore, to be entirely different, and as yet not a single species can be satisfactorily identified as common to both.

The preceding observations may be summarized or recapitulated as follows :—

1. That in Europe there are beds of passage which connect the marine deposits of the Oolitic or Upper Jurassic epoch with those of the Cretaceous, but that similar transitional strata have not yet been recognized in America.

2. That some of the Queen Charlotte Island fossils bear a considerable resemblance to European Oolitic types, but that this analogy is often of a very general character, and can scarcely in any case be shown to amount to actual specific identity.

3. That among the specimens collected by Mr. Richardson there are at least one or two species which are known to be Cretaceous : also, that the collection indicates a fauna much more like that of the Shasta Group of California and British Columbia than that of the coal-bearing series of Vancouver and the adjacent islands.

While, on the one hand, the fossils described in these pages show that the probable geological position of the beds which contained them is near the base of the Lower Cretaceous formation, or top of the Upper Jurassic, they are insufficient to mark the definite horizon to which the series should be referred. It is sufficiently obvious that they exhibit a blending of the life of the Cretaceous period with that of the Jurassic, and perhaps the best course would be to regard the Queen Charlotte Island series provisionally as merely one of the oldest members of the Shasta Group, until the organic remains of the beds associated together under that name are better understood.

The Carbonaceous shales near Cowgitz contain a *Unio* which can scarcely be distinguished from a Wealden species, and this circumstance, though it certainly seems to tend towards the establishment of a connection between the Queen Charlotte Island rocks and the Wealden of Europe, throws no light upon the exact age of the former. The Wealden is a purely local deposit, which by some writers is regarded as synchronous with the Lower Neocomian, and by others as belonging to the

Jurassic formation. Prof. Dana places it (the Wealden) as a separate epoch, intermediate between the Oolitic and Cretaceous periods, but as has been before remarked, it should rather be correlated with one of the marine deposits of the Cretaceous or Jurassic.

At present it would be premature to express any very decided opinion on the exact age of these Coal-bearing rocks. All that the fossils show with any degree of probability is that the series can scarcely be much newer than the Middle Cretaceous, or older than the Upper Jurassic.

*PLATE I.**

Belemnites, Sp. undt. (page 11.)

Figure 1. Guard of the most perfect specimen yet obtained. See also wood-cut No. 1.

" 1 *a*. Phragmocone of another individual of the same species.

" 1 *b*. Outline of transverse section of the original of figure 1, near the apex.

" 1 *c*. Outline of transverse section of ditto, at the anterior or thickest end.

Ammonites Brewerii, Gabb (page 21.)

Figure 2. Side view of the largest example collected. Normal form, with faintly striated surface.

" 2 *a*. Outline of aperture of do. The sides are represented as too straight below, they should curve slightly inwards, from a little beneath the middle of the whorl, to its base.

" 3. Side view of a specimen of the dwarfed costate variety.

" 3 *a*. Outline of aperture of the same.

---

* Unless there is a distinct statement to the contrary, the figures in all the Plates are of natural size.

1.

1a

1b

1c

2

3

3a

2a

PLATE II.

Ammonites Perezianus (page 19.)

Figure 1. Side view of the type specimen.

" 1 *a*. Outline of aperture of the same. The original being rather water-worn, the periphery is represented as too narrow, when perfect it is rather more broadly rounded. The emargination of the base, too, is not nearly deep enough.

Ammonites filicinctus (page 43.)

F iure 2. Side view of a small but very perfect individual.

" 2 *a*. Another representation of the same, to show the shape of the aperture and siphonal edge.

" 2 *b*. Section of do. The edges of the inner walls of the whorls are obliterated.

" 2 *c*. Portion of the test of do., magnified.

" 3. A larger specimen, partly restored.

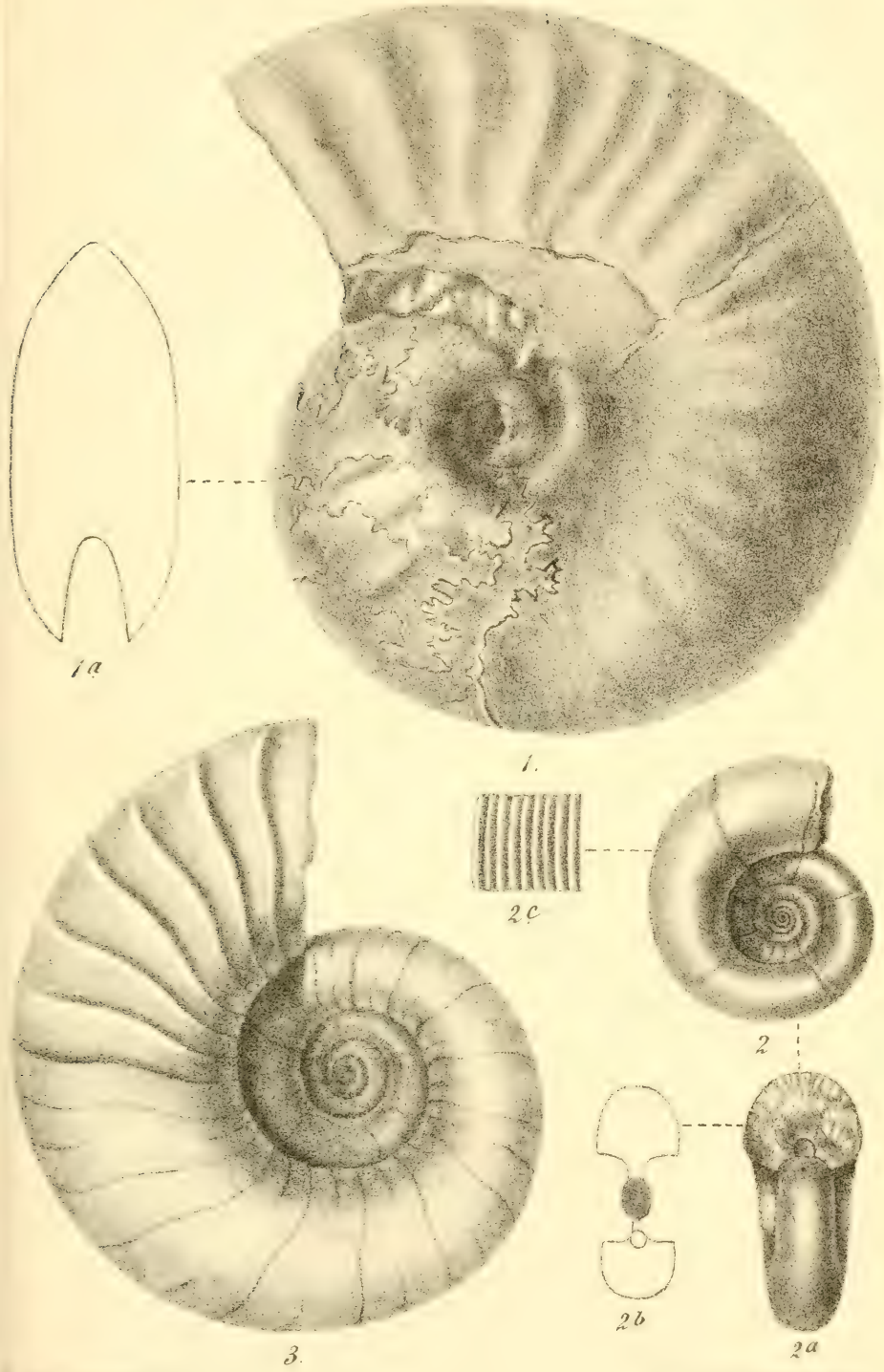

1a
1.
2c
2
2b
2a
3.

PLATE III.

AMMONITES STOLICZKANUS, Gabb, var. spiniferus. (page 24.)

Figure 1. Side view of a distorted and somewhat immature specimen.

AMMOMITES TIMOTHEANUS, Mayor. (page 41.)

Figure 2. A small but perfect example.

" 2 *a*. Another view of the same.

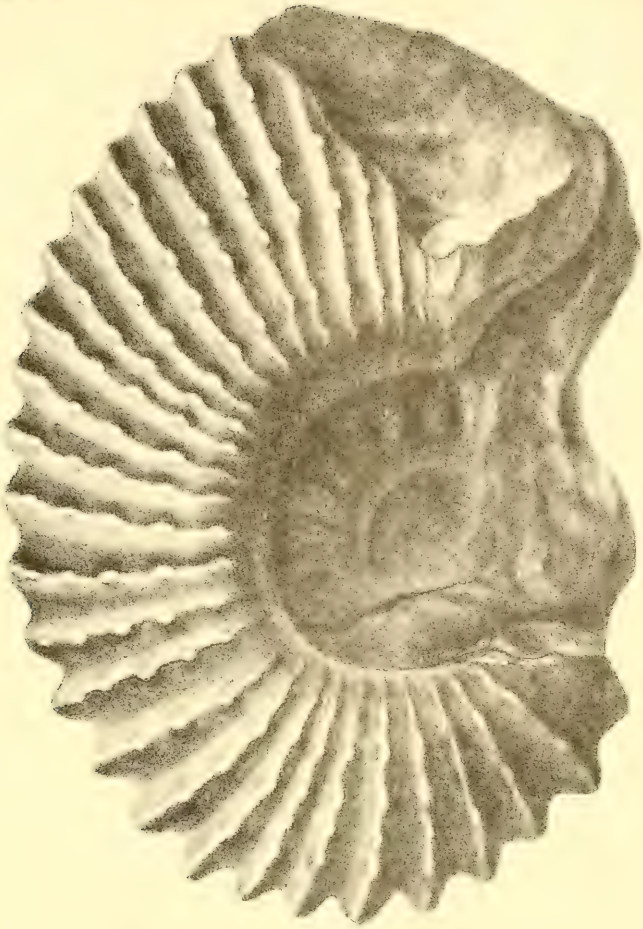
AMMONITES LAPEROUSIANUS (page 39.)

Figure 3. The largest of the two specimens.

AMMONITES, Sp. undt. Near *A. Sim lus*, D'Orb. (page 47.)

Figure 4. Side view.

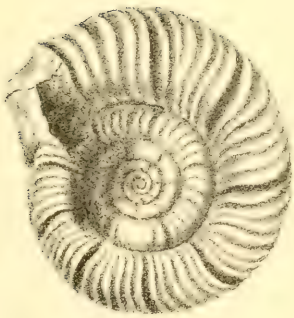
" 4 *a*. Front do.



1

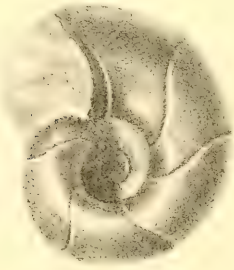
1a

1



3.

2a



2

PLATE IV.

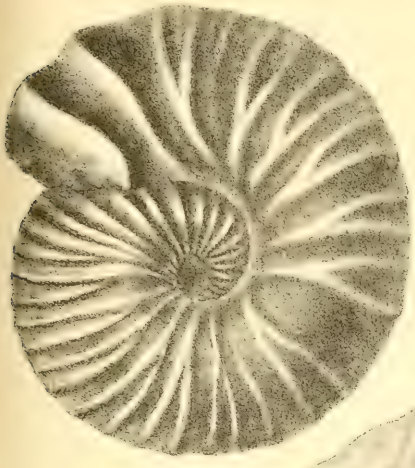
AMMONITES STOLICZKANUS, Gabb, var. spiniferus (page 24.)

Figure 1. A broken but nearly adult example, drawn in such a position as to show the depth and abrupt truncation of the inner edge of part of the body whorl.

AMMONITES LOGANIANUS. Form A. (page 29.)

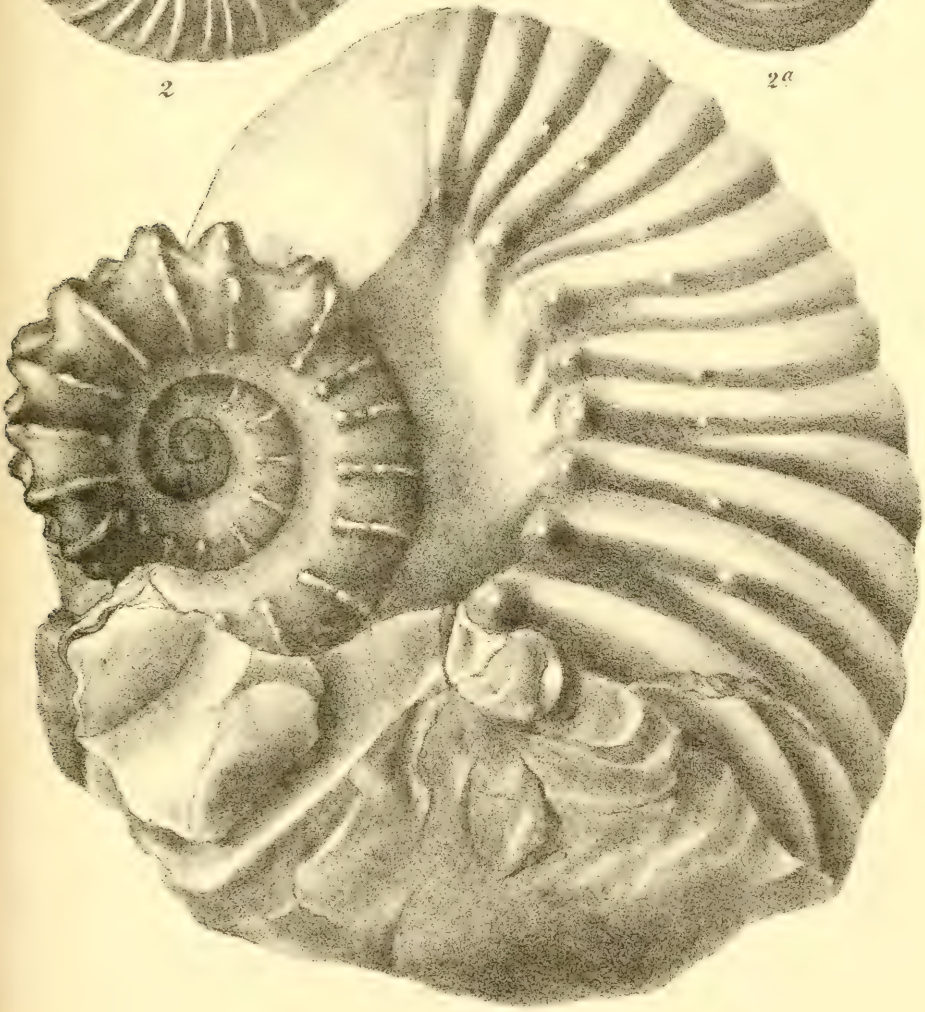
Figure 2. Side view of the only specimen in the collection.

" 2 *a*. Front aspect of the same.



2

2a



1

PLATE V.

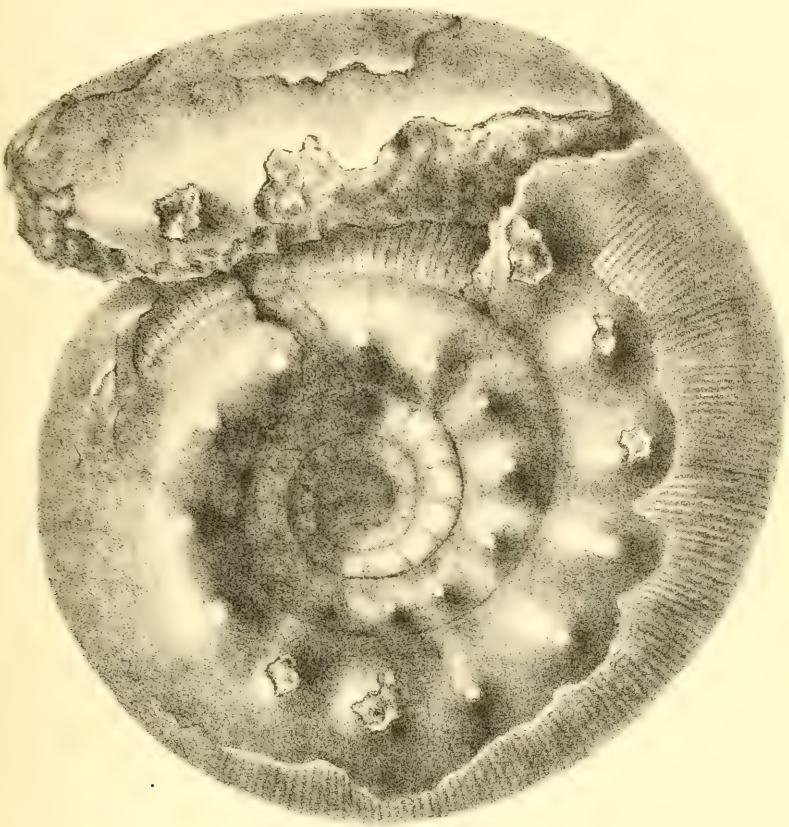
AMMONITES RICHARDSONII (page 32.)

Figure 1. View of the most perfect side of the type specimen.

" 2. Front of do. partly restored.

...OLOGICAL SURVEY ...

1



1.a.

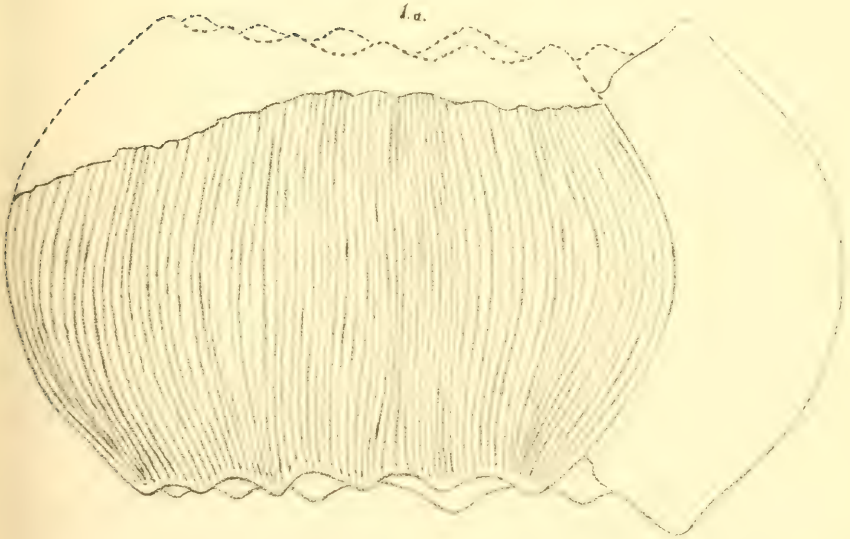


PLATE V.

AMMONITES RICHARDSONII (page 32.)

Figure 1. View of the most perfect side of the type specimen.

" 2. Front of do. partly restored.

PLATE VI.

AMMONITES CARLOTTENSIS (page 38.)

Side view of the type of this species. The shape of the aperture is shown in wood-cut No. 5 on page 38.

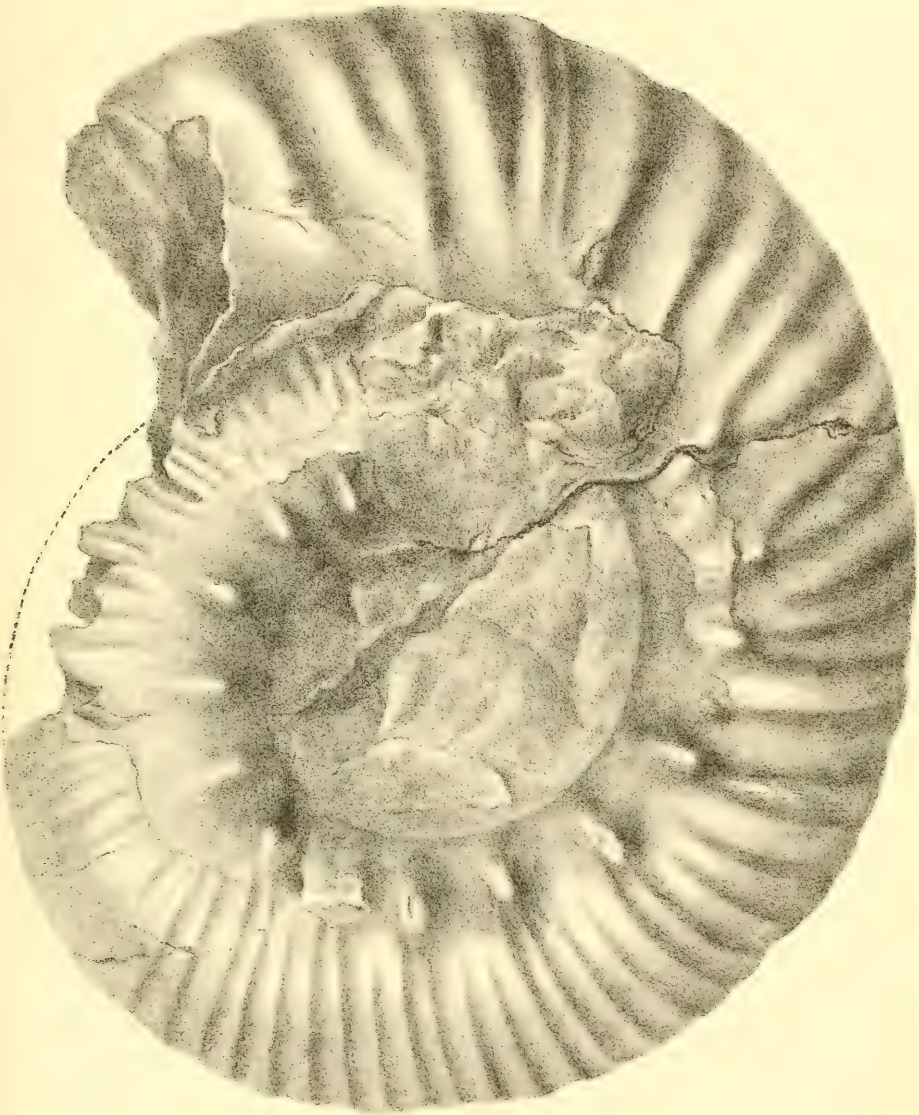
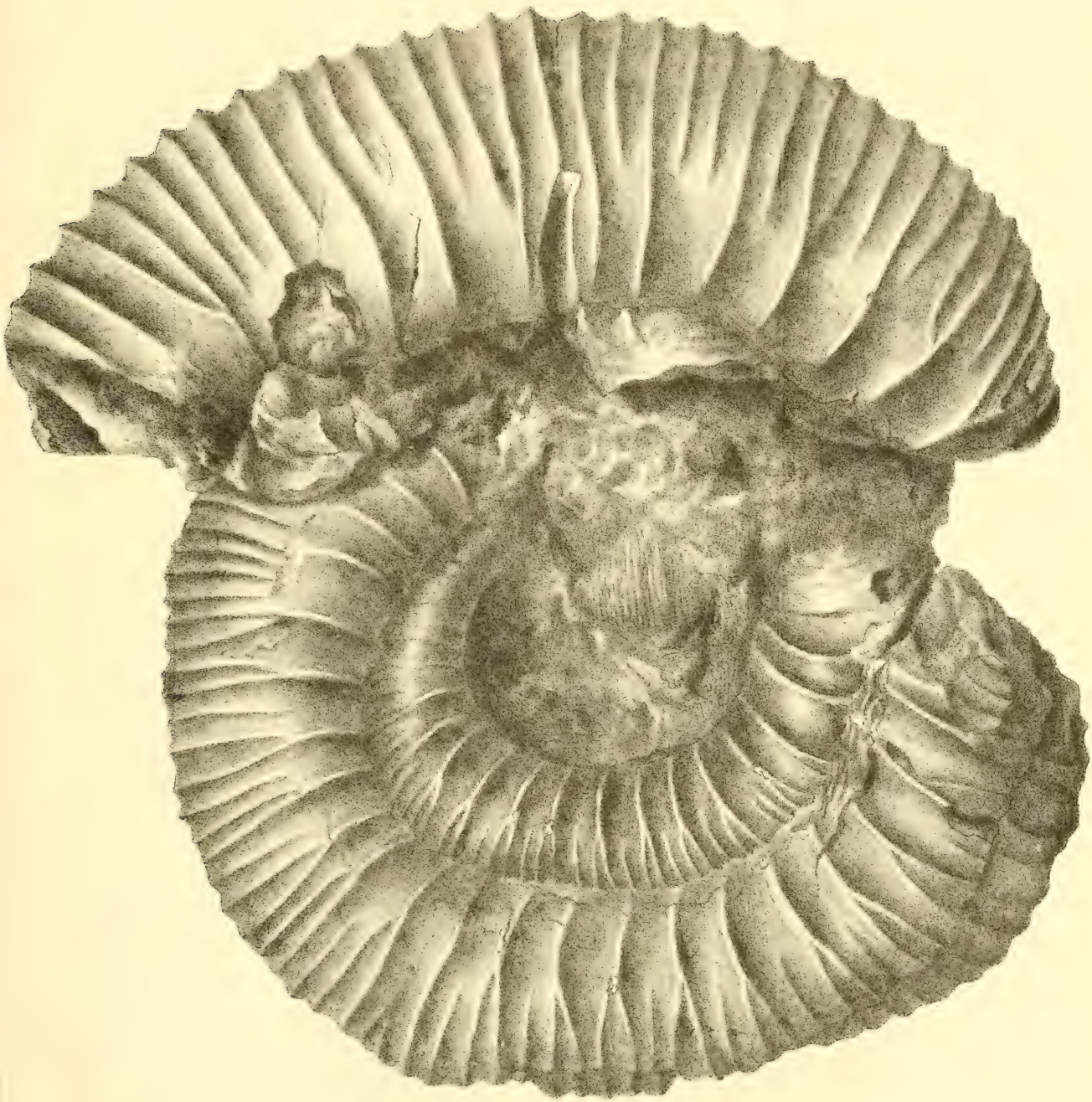


PLATE VII.

AMMONITES SKIDEGATENSIS (page 34).

Side view of the largest individual collected. An outline of the aperture of this specimen is given in wood-cut No. 4, on page 34.



A.H.E. ad. del. et lith.

PLATE VIII.

Ammonites Loganianus. Form B. (page 30.)

Figure 1. Side view, partly restored.

" 1 *a*. Front of the same specimen.

Ammonites Loganianus. Type. (page 27.)

Figure 2. The most perfect side of a crushed and distorted example of this species. The wood-cut (figure 3, on page 28) showing the outline of the aperture, is drawn from another individual.

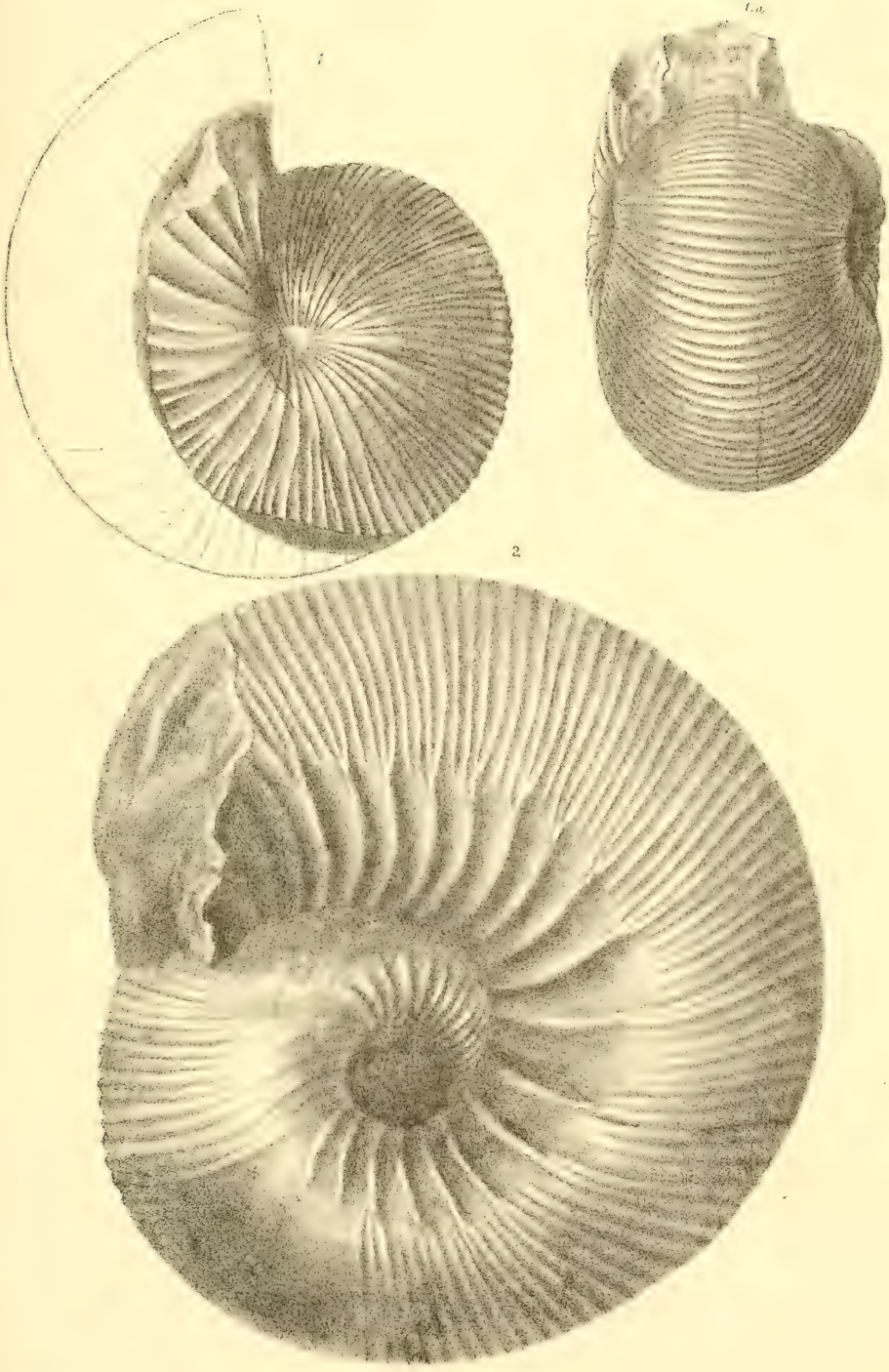


PLATE IX.

Ammonites Skidegatensis (page 34.)

Figure 1. A supposed young individual of this species.

Ammonites crenocostatus (page 45.)

Figure 2. Side view.

" 2 *a*. Portion of the test of do. magnified.

Hamites, Sp. undt. (page 48.)

Figure 3. The only specimen yet obtained.

Amauropsis tenuistriata (page 48.)

Figure 4. Dorsal view of one of the most perfect examples. The two apical whorls are partly restored.

" 4 *a*. Surface markings of the same, magnified.

Scalaria Albensis (? ?), D'Orb. (page 50.)

Figure 5. A fragment of a shell which is very doubtfully referred to this species. It may not be a *Scalaria* at all.

Pleurotomaria Skidegatensis (page 51.)

Figure 6. Dorsal aspect.

" 6 *a*. Base of the same to show its sculpture, also the shape and size of the umbilicus.

Martesia carinifera (page 54.)

Figure 7. Left valve * of the only specimen, magnified about six times.

Pleuromya Carlottensis (page 57.)

Figure 8. Right valve.

Pholadomya ovuloides (page 59.)

Figure 9. Left valve.

Callista subtrigona (page 63.)

Figure 10. Left valve.

Callista, Sp. undt. (page 64.)

Figure 11. Left valve.

Lucina, Sp. undt. (page 61.)

Figure 12. A right valve, with the anterior end downwards. See also wood-cut No. 6.

Unio Hubbardi, Gabb (page 65.)

Figure 13. Right valve of a narrowly elongated variety of this species. The dotted lines are added not by way of restoration, but to show the more usual contour of the posterior end, as seen in other specimens.

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* Most of the lamellibranchiates figured on this and the following Plate have both valves preserved, but the best side has been uniformly selected for illustration.

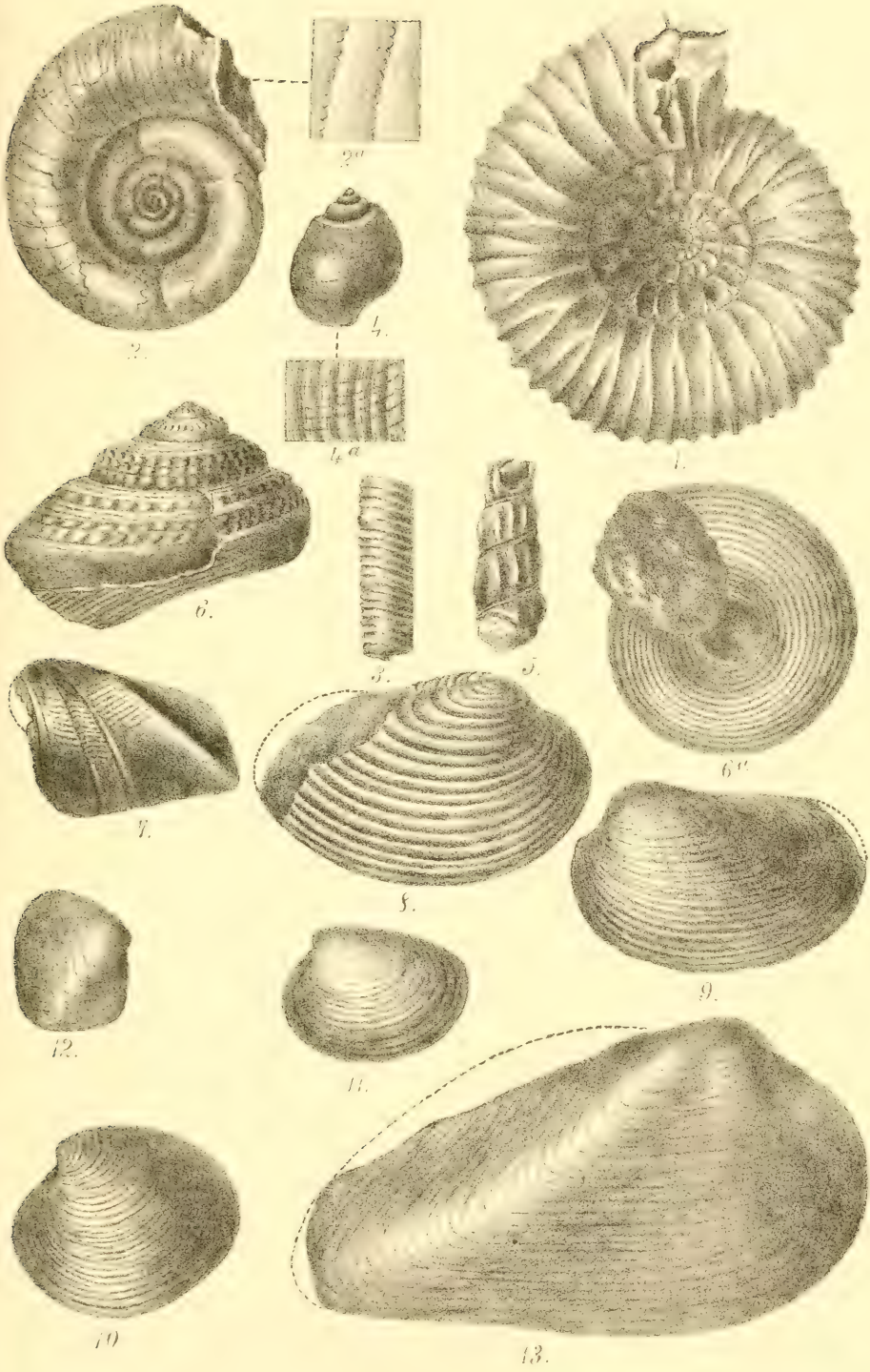

2a
2.
4.
4a
1.
6.
3.
5.
6a
7.
8.
9.
12.
11.
10.
13.

PLATE X.

Trigonia diversicostata (page 68.)

Figure 1 Left valve of an average example.

Trigonia, Sp. undt. (page 70.)

Figure 2. Left valve of an undistorted individual, with a portion of the outer surface of the test preserved. Part of the right valve is also visible.

" 2 *a*. Left valve of a crushed and exfoliated specimen.

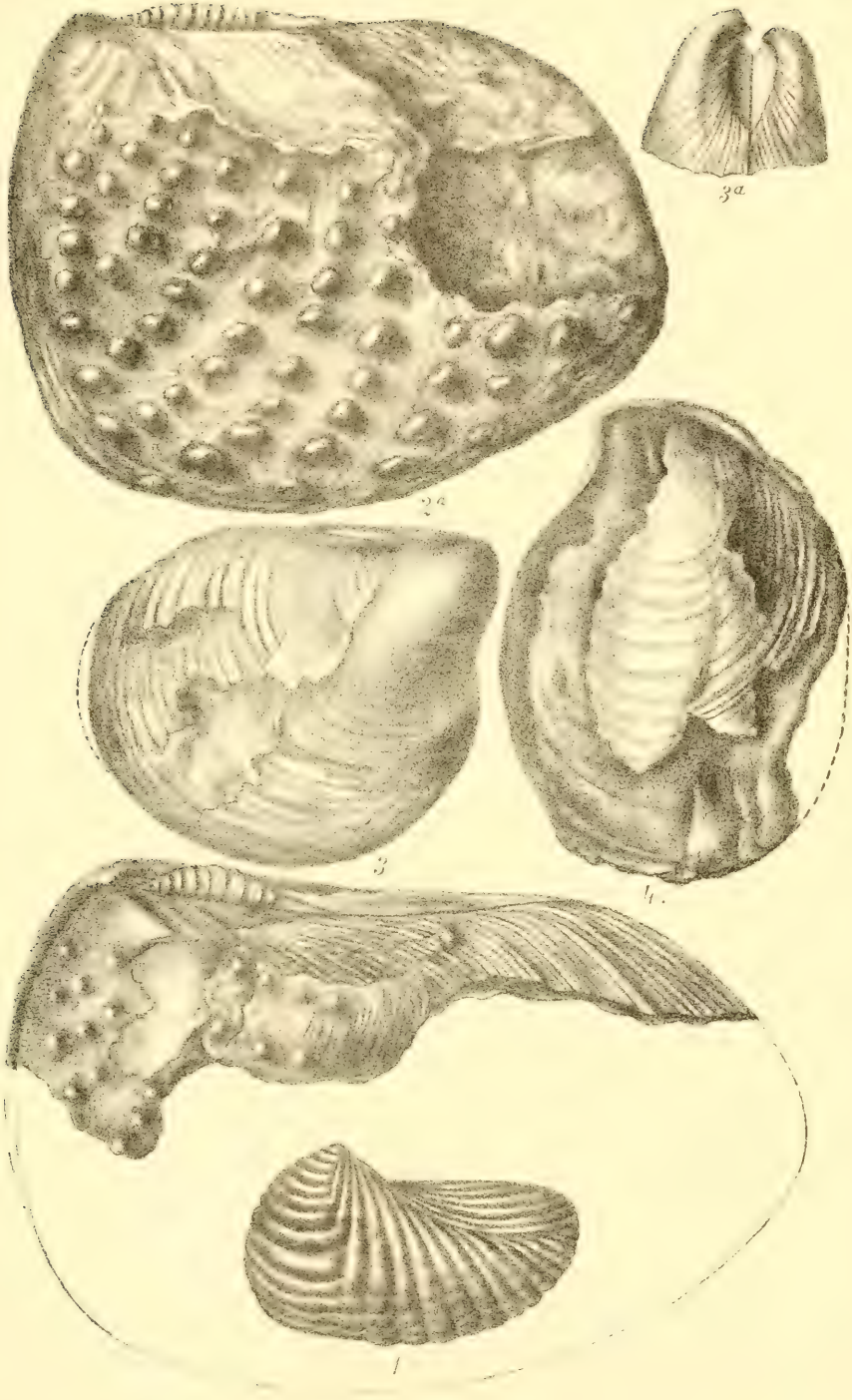
Aucella Mosquensis (?) Von. Buch. (page 74.)

Figure 3. Right valve of a distorted example.

" 3 *a*. Portion of the anterior margin above, to show the inflection of both valves just below the beaks.

Meleagrina amygdaloidea (page 78.)

Figure 4. Right valve of the type of the species.


3a
2a
3
4
1
2

GEOLOGICAL SURVEY of CANADA.
Alfred R.C. Selwyn, F.R.S. &c. Director.
MAP
Shewing the localities of fossils collected
by Mr James Richardson in 1872,
from the
QUEEN CHARLOTTE ISLANDS.
Scale.
INDEX
F. Fossils.
Boundary of Divisions.
Probable continuation of same.
1. Lower shales with coal and iron ore.
2. Coarse conglomerate.
3. Upper shales and sandstones.
See Report of Progress for 1872-73 Page 57.
Lat. 53° 15' N. from Greenwich.
Mt Geneviev
Mt Raymond
Slate Chuck Mts
Mt Stapleton
Nipple Mt
Dome Mt
Mt Needham
GRAHAM ISLAND
Latitude 53° 15' N.
Double Mt
Skidegate
Stone Pk
Village
Fresh Water
Mt Birch
Old Village
Long Arm
Mt Sevenoar
Mt Brown
Hump Mt
Bertie Hill
Slate Chuck Valley
Reef I.
Weed Pt
Upper Shales
Treble Is
Anthracite Coal
Ship Is
Cowgitz
Lat. 53° 12' 31" N.
Lon. 132° 14' 19" W.
Triangle I.
Young Pt
Slaal R.
Anchor Cove
Step Pt
South Pt
Gust I.
Lower Shales
Sand Stone Is
Berry Is
Saltspring B.
No 2 Coal Mine
Lambert Hill.
Mt Chisholm
Snow Peak
Stripe Mt
Mt Rory
Justice B.
Scaulis I.
Connel Pts
Roderick I.
Gooden I.
Maple I.
Image Pt
BEAR SKIN BAY
INAI I.
Low Water Rock.
Channel Is
Tuft I.
Flowery I.
Burnt I.
Wedge I
Angle I.
Howard Pt
SKIDEGATE INLET
George Pt
Rabbit I.
Bush I.
Bare Rocks
Tree I.
Alliford B.
Leading I.
MAUDE I.
Lose Pt
SOUTH I.
MORESBY I.

GEOLOGICAL SURVEY OF CANADA.
ALFRED R. C. SELWYN, F.R.S., F.G.S., DIRECTOR.

MESOZOIC FOSSILS.

VOLUME I.

PART II.—ON THE FOSSILS OF THE CRETACEOUS ROCKS OF VANCOUVER AND ADJACENT ISLANDS IN THE STRAIT OF GEORGIA.

BY J. F. WHITEAVES, F.G.S.,
PALÆONTOLOGIST TO THE SURVEY.

PRINTED FOR THE GOVERNMENT OF CANADA.
DAWSON BROTHERS, PUBLISHERS.
MONTREAL:
1879.

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Museum of Comparative Zoology
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LIBRARY

The Second Part of the present Volume contains identifications and descriptions of all the fossils collected by Mr. Richardson in 1871–75 from the Nanaimo and Comox Coal-fields of Vancouver and some of the islands in the Strait of Georgia, except the plants.

The figures on Plates XI. to XX. have been drawn and lithographed by Mr. A. H. Foord, F.G.S., the Artist to the Survey.

Part III., which is in course of preparation, will complete the Volume.

ALFRED R. C. SELWYN,
Director Geological Survey.

Geological Survey Office,
Montreal, *May 6th*, 1879.

GEOLOGICAL SURVEY OF CANADA.

10,039

MESOZOIC FOSSILS.

Museum of Comparative Zoology
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BY J. F. WHITEAVES.

VOLUME I.

II. *On the Fossils of the Cretaceous Rocks of Vancouver and Adjacent Islands in the Strait of Georgia.*

Prefatory Remarks.

The fossils described in the following pages were collected by Mr. James Richardson from the south-eastern portion of Vancouver Island and from several islands in the Strait of Georgia, during the summer seasons of 1871 to 1875, inclusive. In order, however, to present as complete a report as possible on the present state of our knowledge of the fossil fauna of these deposits, the names of species described or recorded from them by other naturalists, but which were not met with by Mr. Richardson, have been added in their proper places between parentheses.

According to Mr. Richardson's published reports,* the coal-bearing strata of this part of Vancouver Island occupy a long, narrow strip on the shores of the Georgian Strait, but in the neighbourhood of Nanoose Harbour the continuity of the formation is broken by crystalline rocks, which divide it into two local and subordinate areas, one of which has been called the Comox, and the other the Nanaimo Coal-Field. The two together are believed to form part of a synclinal axis, whose north-east side lies beneath the waters of the Strait of Georgia, and the limits of each are shewn in detail in the maps which accompany Mr. Richardson's reports.

The Comox Coal-field extends from the north-west of North West Bay to Cape Mudge, and includes Denman and Hornby Islands. The following

* Geological Survey of Canada, Reports of Progress from 1871-72 to 1876-77, inclusive.

is a general section of the entire series as developed in this area, in descending order:—

COMOX SECTION.

	FEET.	IN.
G. Upper Conglomerates	320	0
F. Upper Shales	776	6
E. Middle Conglomerates	1,100	0
D. Middle Shales	76	0
C. Lower Conglomerates	900	0
B. Lower Shales	1,000	0
A. Productive Coal Measures	739	6
Total	4,912	0

The Nanaimo Coal-field commences at a distance of about fifteen miles from Victoria and reaches to Nanoose Harbour, including within its boundaries a number of islands in the Georgian Strait, from the Sucia Group on the south-east, to Gabriola Island on the north-west. It has been found impracticable to define the upper groups of the Comox section in the Nanaimo area, and the rocks of the latter have accordingly been grouped provisionally, as follows:—

NANAIMO SECTION.

		FEET.
G. to C. Sandstones.	Thickness estimated at	3,290
B. Shales	" " "	660
A. Productive Coal Measures.	" " "	1,316
Total		5,266

From this it would appear that the thickness of the formation is somewhat greater in the Nanaimo than in the Comox area.

The organic remains obtained by Mr. Richardson from these deposits are, first, a small but interesting series of fragments of land plants, which have already been partly reported on by Principal Dawson, but which require further study; and, secondly, a collection of one hundred species of marine invertebrates, of which ninety-six belong to the Mollusca proper, three to the Brachiopoda, and one to the Anthozoa. Of the true Mollusca more than one-half the species are Lamellibranchiate bivalves, and in the same way the Gasteropoda are much more abundantly represented than the Cephalopoda.

In both coal-fields most of the shells are from Division A., but in the Comox area a considerable number of species were collected from the Lower Shales (Division B.) of the south-west side of Denman Island and elsewhere; also from the Middle Shales (Division D.) of the west and north-west side of Hornby Island. In the Comox basin only,

some fossil leaves and fragments of wood were found in the upper divisions (E. F. and G.,) also one or two obscure organisms in the middle conglomerates (E.,) but these last may have been derived from the underlying Middle Shales, or Division D.

The fossils, as a rule, are remarkably well preserved, but as they are nearly always much softer than the hard and tough matrix in which they are imbedded, it is difficult to hammer them out without breaking them. By far the largest number of species from any one locality, and the most perfect specimens, were collected by Mr. Richardson in 1874 and 1875 from the south-west side of the largest island of the Sucia group, in Washington Territory. These islands, however, as already mentioned, are situated within the limits of the Nanaimo Coal-field, and many of the species found in them occur also on Vancouver or on other islands in the Strait of Georgia.

In a paper read before the Geological Society of London in April, 1861,* and since printed in its proceedings, Dr. Hector says: "Some fossils transmitted to the Jermyn Street Museum many years ago" from Vancouver Island "were first rightly recognised by the late Professor E. Forbes, as being Cretaceous,"† but as far as the writer has been able to ascertain, no statement to that effect was ever published by Forbes. Mr. F. B. Meek appears to have been the first palæontologist who published specific descriptions of fossils from this part of the Vancouver Cretaceous. His earliest paper on the subject appeared in 1857, and from that year to the close of 1876, thirty-four species of mollusca from these rocks have been described either by Mr. Meek, Dr. B. F. Shumard, or Mr. W. M. Gabb. The following are the titles of the papers in which these descriptions are to be found, with references to the publications in which they appeared:—

1857. *Meek, F. B.*—"Descriptions of New Organic Remains from the Cretaceous Rocks of Vancouver Island." Transactions of the Albany Institute, Vol. IV., pp. 37-49.

Twenty species of mollusca from Nanaimo are characterised in this paper.

1858. *Shumard, Dr. B. F.*—"Descriptions of New Fossils from the Tertiary formations of Oregon and Washington Territories and the Cretaceous of Vancouver's Island, collected by Dr. John Evans, U. S. Geologist, under instructions from the Department of the Interior." Transactions of the Academy of Science of St. Louis, Vol I., pp. 120-125.

Three of the species are from Nanaimo.

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* "On the Geology of the Country between Lake Superior and the Pacific Ocean (between the 48th and 54th parallels of latitude), visited by the Government Exploring Expedition under the command of Captain J. Palliser. By James Hector, M. D."—Quart. Jour. Geol. Soc. Lond., Vol. XVII, pp. 388-445.

† Do. p. 429.

1861. *Meek, F. B.*—" Descriptions of New Cretaceous Fossils collected by the North-West Boundary Commission on Vancouver and Sucia Island. Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. XIII., pp. 314-318.

Seven species are described in this article, four from Comox (or Koomooks, as Mr. Meek writes it,) one from Nanaimo and two from the Sucia Islands, but one of these, *Baculites occidentalis*, was described in Mr. Meek's first paper under another name.

1864. *Gabb, W. M.*—Palæontology of California, Vol. I.

Contains descriptions and figures of *Hamites Vancouverensis* and *Pecten Traskii*, from Nanaimo.

1869. *Gabb, W. M.*—Palæontology of California, Vol. II.

Three new species of Lamellibranchiate bivalves from Nanaimo are described and figured in this volume.

1876. *Meek, F. B.*—" Descriptions and Illustrations of Fossils from Vancouver and Sucia Islands and other North-Western Localities." Bulletin of the Geological and Geographical Survey of the Territories, Vol. II., No. 4, pp. 351-374, plates 1-6.

A reprint of the two previously mentioned articles by this writer, with additions and illustrations.

Mr. Bauerman, in a communication to the Geological Society of London, " On the Geology of the South Eastern part of Vancouver Island,"* gives the generic names only of a few fossils from Nanaimo and Comox, and Dr. Hector's memoir, already referred to, contains two short lists of Cretaceous shells, determined by Mr. Etheridge, one of the Nanaimo† and the other of the Comox and Valdez Inlet species,‡ none of which are new to science.

Most of the fossils described or recorded in the papers mentioned above have been recognized in Mr. Richardson's collections, upon which some notes have been published by Mr. Billings in the Report of Progress for 1872-73, and by the writer in that of the following year.

In closing these preliminary observations, the writer gladly avails himself of the opportunity of acknowledging his obligations to Mr. A. H. Foord, for the care with which the drawings of the different species have been made, and for valuable assistance rendered in the elimination of the structural characters of the latter; also to Prof. E. W. Claypole, of Antioch College, Yellow Springs, Ohio, for advice in regard to the best and most classical construction of some generic and specific names.

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* Quarterly Journal of the Geological Society of London, November, 1858, Vol. XVI., pp. 198-202.
† " " " " " April, 1861, Vol. XVII., p. 432
‡ " " " " " " " " p. 434.

DESCRIPTIONS OF SPECIES.

CEPHALOPODA.*

Nautilus Suciensis. (N. Sp.)

Plate 11, figures 1 and 1*a*.

Perhaps a variety of *Nautilus Albensis*, Pictet & Campiché (as of D'Orbigny,) Matériaux pour la Paléontologie Suisse. Description des fossiles du Terrain Crétace des environs de Sainte Croix, Pt. 1, pp. 121 and 134, pl. 17.

Shell subglobose, broadly rounded on the periphery and somewhat compressed at the sides; umbilicus closed, umbilical region shallowly concave. Aperture reniform-sublunate, wider than high, deeply emarginate at the base. Measured along the median line, where the emargination is greatest, the height of the aperture is about one-third less than its width, and outside of the emargination the width still slightly exceeds the height. Septa distant, slightly flexuous; near the umbilical depression they curve abruptly and convexly forwards, then backwards in a much more elongated but shallowly concave curve, which extends over the greater part of the side, after which they cross the periphery in almost straight lines. Siphuncle nearly central, but placed a little on the inner side of the centre of each septum.

Outer half of the last volution marked by broad, rounded, but much flattened, undulating ribs, which are obsolete on and immediately around the umbilical depression, but which are more strongly marked on and towards the periphery. On the outer portion of the sides they curve boldly and convexly forwards, and in passing over the periphery they each run parallel with the broadly concave, but not very deep or angular sinus of that part of the outer lip. Those which are farthest from the aperture are parallel with each other, but those nearer the mouth coalesce obscurely, in an alternate fashion, just before crossing the periphery. Between four and a-half and five ribs can be counted in the length of an inch. The remainder of the surface is either smooth, or else very finely striated across, the striæ taking the same direction as the ribs.

One very well preserved, but somewhat distorted specimen, (the one figured), and a portion of another, were collected by Mr. Richardson,

---

* In the classification of the Mollusca and Molluscoidea, the writer has followed, as nearly as possible, the order adopted in the "Arrangement of the Families of Mollusks, prepared for the Smithsonian Institution, by Theodore Gill, M.D., Ph.D.," published at Washington in 1871.

from the "Productive Coal Measures," or Division A., of the Sucia Islands,* in the summer of 1874. The most perfect of these has already been briefly characterised on page 17 of this volume, but the statement there made that "the siphuncle is situated a little on the outside of the centre of the septa," has since been found to be incorrect, and the inferences drawn under this impression, viz., that the shell is probably only a variety of *Nautilus Atlas* (nobis), and that it agrees almost exactly with Meek's diagnosis of the Nebrasca shell figured as *N. elegans*, are, of course, no longer tenable. When the first description of the Sucia Island *Nautilus* was written, the lower part of the only septum in which the siphuncle could be traced was covered by the matrix, and sufficient allowance was not made for the depth of the emargination at its base. While endeavouring, subsequently, to remove part of the matrix, a piece of the septate portion became detached in such a way as to expose the whole of the convex surface of this septum, the eighth from the aperture, most of which had previously been hidden from view. On account of the rounding off of the margin it is difficult to give very accurate measurements, but, as nearly as can be ascertained, the height of this septum, in the centre, is nine lines, and the middle of the siphuncle is about five lines from the outer and four from the inner margin of the septum. In the other specimen, which is a cast of the body chamber, with one of the so-called air chambers attached, the whole of the convex side of the last septum but one is fully exposed. Following its convexity throughout, along the median line, the total height of this septum is twenty-three lines, and the centre of the siphuncle is thirteen lines distant from the periphery and ten lines from the inner margin of the septum. Thus it would appear that the siphuncle is placed a little on the inner side of the centre, at a distance from it about equal to its own diameter.

This species seems to be more closely allied to the *Nautilus Albensis* and *N. Neckerianus*, as described by Pictet and Campiché in the Paléontologie Suisse, than to any of the ribbed Nautili from the Cretaceous rocks of North America. In *N. Albensis* the siphuncle is situated at one-third the height of the septum, on the inner side of its centre, and this is the only difference at present obvious between it and *N. Suciensis*. The position of the siphuncle appears to be precisely similar in *N. Neckerianus* and *N. Suciensis*, but the former shell has much more

* The words "Sucia Islands," as applied to specimens collected by Mr. Richardson, are invariably employed as an abbreviation for south-west side of the largest island of the Sucia group.

numerous and more strongly marked ribs, which are alternately short and long, and its umbilicus, though closed in some specimens, is open enough in the majority to expose some of the inner whorls. *Nautilus Neckerianus*, moreover, is one of the characteristic fossils of the Lower Greensand, whereas the rocks in which *N. Suciensis* occurs can scarcely be older than the Gault, and are probably of a much more recent date.

Nautilus Campbelli, Meek.

Plate 11, figures 2, 2*a* and 2*b*.

Nautilus Campbelli Meek.—Proc. Ac. Nat. Sc., Phil., 1861, page 318.
" " " Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4, p. 373, pl 6, figs. 2, 2*a*.

Comox, Vancouver Island. Meek. Middle Shales, Division D., of the North-West side of Hornby Island; J. Richardson, 1872; and Productive Coal Measures, or Division A., of the Sucia Islands; J. R., 1875. One specimen from each locality.

The position of the siphuncle of *Nautilus Campbelli* was unknown to its describer, but the two specimens collected by Mr. Richardson, both of which are half-grown shells, shew this character with great clearness, and give some additional information about the species. The siphuncle is placed very near to the inner margin of the septum, its distance from the periphery being four-fifths the entire height, at least, in comparatively young shells. The septum figured is the largest one obtained: following its concavity the entire height along the median line is ten lines, and the centre of the siphuncle is eight lines from the outer and two from the inner margin. The umbilicus is deep but narrow, and remains of it are sometimes left as hollow, funnel-shaped, shelly cones projecting on either side of the early volutions. The surface of the latter, as viewed under an achromatic microscope with an inch and a-half objective, is seen to be marked by shallowly concave revolving grooves, and these are crossed by rather distant, transverse, crenate ridges, the intervals between which are almost filled by close set, numerous crenate striæ which run parallel both to each other and to the ridges.

(Nautilus Dekayi, Morton.

Nautilus Dekayi, Morton.—Synops. Org. Rem. Cr. Rocks of U. S., p. 33, pl. 8, fig. 4.
" " " Meek, Rep. Inv. Cr. and Tert. Foss. of U. Miss. Co., p. 496, pl. 27, figs. 1*a*, *b*, *c*, *d*, *e*.

On page 124 of the first volume of the Transactions of the Academy of Science of St. Louis, dated 1857, Dr. B. F. Shumard says that "a

Nautilus which appears to be identical with *N. Dekayi*, Morton," occurs in "the dark, argillaceous, compact limestone of Nanaimo River, Vancouver Island," associated with *Inoceramus Vancouverensis* and other Cretaceous fossils. Imperfect or badly preserved specimens of *Nautilus Campbelli* are difficult to distinguish from *N. Dekayi*, and as Dr. Shumard states that his fossil was in bad condition, it is quite likely that the *Nautilus* which he supposed might be *N. Dekayi* was really *N. Campbelli*, especially when it is borne in mind that the latter species was not described by Meek until 1861, four years after the publication of Dr. Shumard's paper. However this may be, the existence of *Nautilus Dekayi* in the Vancouver Cretaceous is not very satisfactorily established, and needs confirmation. It has not yet been recorded from rocks of similar age in California.)

(Heteroceras Cooperi, Gabb. (Sp.)

Ammonites (?) Cooperi, Gabb.—Palæontology of California, Vol. I., p. 69, pl. 14, figs. 22 and 23*a*.

Heteroceras Cooperi, Meek.— Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4, p. 367, pl. 3, figs. 7 and 7*a*.

Comox, Vancouver Island. Meek. Not in any of Mr. Richardson's collections.)

Heteroceras Conradi, Morton. (Sp.)

Plate 12, all the figures.

Ammonceratites Conradi, S. G. Morton.—Jour. Ac. Nat. Sc., Phil., 1839, Vol. VIII., p. 212, pl. 10, fig. 1.

More or less fragmentary specimens of a large *Heteroceras* were collected by Mr. Richardson, from the Middle Shales, or Division D., of the North-West side of Hornby Island (one) in 1872; from the Lower Shales, or Division B., of the Trent River (two from above and one from below the falls), and at Bradley Creek, V. I., in 1872; also from the Productive Coal Measures, Division A., of Salt Spring or Admiralty Island (two), and at Maple Bay, V. I. (five), in 1875.

The most perfect are those from the last mentioned locality, three of which are represented on plate 12. The original of figs. 1 and 1*a* in that plate has an entire whorl and a considerable portion of the two preceding ones preserved in place, also a detached piece of the uncoiled part of the shell, which was found lying immediately across its umbilical opening

and partly covered by the matrix, which has since been removed. Figs. 2 and 2*a* are different views of a fragment, which consists of one of the earliest volutions, evidently not far from the nucleus, and fig. 3 is a part of the shell which corresponds very nearly to the piece described by Morton as *Ammoniceratites Conradi*. The specimens are often distorted, yet taken collectively they give a tolerably good general idea of the shape and sculpture of most of the shell. The whorls are rounded and are at first coiled in a dextral and somewhat regular spiral, but the last one is free and partially uncoiled. Those of the spire are contiguous, and are enrolled in such a manner as to leave a very deep and moderately wide umbilical cavity which extends nearly to the nucleus. The width of the umbilicus is rather less than one-third that of the greatest diameter of the shell (which measures three inches and a-quarter in the largest specimen,) and it is as wide in proportion in the earliest volution known. The number of whorls in the coiled part was probably about five, and the height of the spire appears to have exceeded its greatest width. The exact direction taken by the free termination of the shell is not yet known. In some specimens, especially in that from which fig. 3 was taken, the whorl suddenly takes a decidedly upward curve apparently just previous to uncoiling, but in another individual (which, however, is obviously distorted) the upward curve is not quite so strongly marked and it subsequently seems to slope convexly downwards again.

The surface is marked by rather distant, prominent and very acute, transverse ribs, which are much narrower than the rather deeply concave grooves between them. The ribs are flexuous above and comparatively straight on the lower or umbilical face: in most specimens they are both simple and parallel, but in one example some of the costæ bifurcate near the middle of the sides. Septum unknown.

The writer has long been convinced that the fossils described above are specifically identical with the New Jersey *Heteroceras* described and figured by Morton under the name *Ammoniceratites Conradi*, and Mr. G. W. Tryon, who has compared the two best Maple Bay specimens (the originals of figures 1 and 3 of plate 12) with Morton's type of *A. Conradi*, and with another cast of the same species, from Shell Town, N.J., labelled by Mr. Conrad, both in the Museum of the Academy of Natural Sciences of Philadelphia, has come to the same conclusion. In a letter, dated March 5th, 1878, Mr. Tryon says: "I have carefully compared your specimens of *Heteroceras* with our types and find no difference which cannot be assigned to compression. The ribs on your specimens are

much more sharply defined than on ours, your casts being very much more perfect, but the relative sizes of ribs and interspaces are the same."

AMMONITES.

Group I.—Lævigati, Forbes.

Sub-genus Haploceras, Zittel.*—"Palæontologische Mittheilungen dem Museum des Kœniglichen Bayer. Staats." Cassel, 1870. Vol. II., p. 166.

Ammonites Gardeni, Baily.

Ammonites Gardeni Baily.—Quart. Jour. Geol Soc., London, 1855, Vol. II., p. 456, pl. 11, fig. 3.
" " " Stoliczka, Cret. Ceph. S. India, p. 61, pl. 33, fig. 4.

Lower Shales, Division B, at Bradley Creek (two specimens), and on the banks of the Trent River, V. I., above the falls (one example); also Productive Coal Measures, Division A, ten miles up the Nanaimo River, V. I.; J Richardson, 1872 and 1874.

Ammonites Gardeni has a very wide geographical distribution. The specimens originally described by Baily were from Cretaceous deposits in the neighbourhood of Natal, and the species has since been found in rocks of similar age at three different localities in Southern India. Dr. Stoliczka thinks that the *Ammonites sulcatus* of Kner, from Lemberg in Austrian Poland, may be synonymous with *A. Gardeni*, and if this be the case the latter shell occurs also in Europe. The four Ammonites from the above mentioned localities in Vancouver Island are referred to *A. Gardeni* with some confidence.

(Ammonites geniculatus, Conrad.

Ammonites geniculatus, Conrad.—Emory's Rep. on the U. S. and Mex. Bound. Surv., 1857, Vol. I., p. 159, pl. 15, figs. 2*a*, b.

Identified by Mr. Etheridge as occurring at Comox or Valdez Inlet,† but no other naturalist has met with it in the Vancouver Cretaceous. The only Ammonite with a simple keel in Mr. Richardson's collections is *A. Gardeni*.)

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* Teste Neumayr, in a paper entitled "Die Ammoniten der Kreide und die Systematik der Ammonitiden." Zeitschrift der Deutschen Geologischen Gesellschaft, Berlin, 1875, Vol. XXVII., p. 915.

† Quarterly Journal of the Geological Society of London, April, 1861, Vol. XVII., page 434.

Group II.—Dentati, Von Buch.

Sub-genus Placenticeras, Meek.—Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country. Washington, 1876. Pages 462 and 463.

Ammonites Vancouverensis, Meek.

Ammonites Vancouverensis, Meek.— Proc. Ac. Nat. Sc., Phil., 1861, Vol. XIII., p. 317.

Placenticeras (?) Vancouverensis, Meek.—Bul. Geol. and Geogr. Surv. Terr., Vol. II., No. 4, p. 370, pl. 6, figs. 1, 1*a*, 1*b* and 1*c*.

Comox, Vancouver Island. Meek. Sucia Islands, in Division A.; J. Richardson, 1874. Three characteristic examples.

Group III.—Heterophylli, D'Orbigny.

Sub-genus Phylloceras, Suess.—"Ueber Ammoniten." Sitzungsberichte der K. K. Akad. der Wissenschaften. Vienna, 1865. Vol. LII., p. 52.

Ammonites Velledæ, Michelin.

Ammonites Velledæ, Mich., D'Orb. —Pal. Franc., Terr. Cret., Vol. I., p. 280, Atlas, pl. 82.

" " " Pictet —Pal. Suisse, Foss. de St. Croix, Vol. I., pp. 268 and 348, pl. 36, fig. 8.

" " " Stoliczka —Cret. Ceph. S. India, p. 116, pl. 59, figs. 1–4.

Ammonites (Scaphites?) ramosus, Meek.—Trans. Alb. Inst., 1857, Vol. IV., p. 45.

*Phylloceras ramosus** (sic), Meek. —Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4, p. 371, pl. 5, figs. 1, 1*a*, and 1*b*.

Comox, Vancouver Island. Meek. Sucia Islands, in Division A.; J. Richardson, 1874. One well preserved fragment.

An attentive consideration of the diagnoses and figures of the two shells, has forced the writer to the conclusion that the *A. ramosus* of Meek is synonymous with the *A. Velledæ* of Michelin and other European palæontologists.

Mr. Meek, after admitting that the shape and surface markings of both are alike, goes on to say: "When we compare the septa, however, they are at once seen to present marked differences, such as are clearly incompatible with specific identity, *if D'Orbigny's figures are correct.*" The qualification italicized shews that Meek had not compared his shell with either Pictet's or Stoliczka's descriptions or illustrations of *A. Velledæ*.

* Meek writes this word "ramosus," but Phylloceras is neuter.

In D'Orbigny's figure of the septum of *A. Velledæ*, the siphonal saddle (or small saddle through which the siphon passes) is represented as lanceolate with an entire margin; whereas the corresponding saddle in *A. ramosus* is figured by Meek as three lobed or twice incised at the summit, and this difference might be, and indeed has been, looked upon as of specific importance. The value of this character, however, is entirely negatived by the fact that Pictet and Stoliczka both represent the siphonal saddle of *A. Velledæ* as three lobed or twice incised at the apex, and their figures of the septum of that species agree precisely with Meek's drawing or tracing of the septum of *A. ramosus*. The plates of Ammonites in the first volume of the "Palèontologie Suisse" shew that the shape of the siphonal saddle varies considerably in different individuals of the same species, and suggest grave doubts as to the validity of distinctions which are founded only on supposed differences in this part of the septa*.

Ammonites Selwynianus. (N. Sp.)

Plate 13, figures 1 and 1*a*.

Shell somewhat compressed at the sides and rounded on the periphery; umbilicus extremely small; surface of the test marked by fine, flexuous striæ, which curve forwards and form long beak-like processes on the siphonal edge; cast impressed by distant, periodic grooves, which curve in the same direction as the striæ on the test.

Whorls strongly involute, nearly the whole of the inner turns being concealed; outer volution moderately inflated, thickest near the middle of the sides and slightly depressed round the umbilical opening. Umbilicus rather less than one-tenth of the greatest diameter of the shell, very deep, with a rounded margin and almost perpendicular sides. Aperture ovate, wider above than below, and very deeply emarginate for the reception of the previous volution. Measured along the median line, where the emargination is deepest, the width of the aperture is greater than its height, but outside of the emargination the entire height of the whorl or aperture is much greater than its width.

Test ornamented by faint and very delicate, flexuous striations,

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* On pp. 43-45 of the present Volume, five Ammonites from the Queen Charlotte Islands were described under the name *A. filicinctus*, and these were separated from *A. Sacya* (Forbes) on precisely the same grounds as those which were relied upon by Meek for distinguishing his *A. ramosus* from *A. Velledæ*—viz., a supposed difference in the shape of their siphonal saddles. At the time that *A. filicinctus* was described, the writer had not access to the "Palèontologie Suisse," and consequently was not then aware that the shape of the siphonal saddles was variable in different specimens of the same Ammonite; but the work referred to has since been added to the Library of the Survey, and it is now almost certain that *A. filicinctus* is identical with *A. Sacya*.

which commence at the umbilicus, curve a little forwards and then gently backwards across the sides, after which they form a series of elongated, beak-like processes with concave sides in passing over the periphery, Underneath the shell there are seven constrictions or grooves on the cast of the outer whorl. These are the remains of former lips, whose curves are precisely parallel with the flexuous striæ of the test. Septation unknown.

Greatest diameter of an average sized individual, twenty-seven lines; width of umbilicus of the same, not quite two lines and a-half. Maximum width of the aperture, ten lines and a-half; height of do., outside of the emargination, fourteen lines; depth of the emargination, six lines and a-half.

Sucia Islands, in Division A.; J Richardson, 1874. Nine good specimens.

This species appears to be more closely allied to *Ammonites subalpinus*, D'Orbigny, and *A. diphylloides*, Forbes, then it is to *A. ramosus* or *A. Velledæ*. Besides having much flatter shells than *A. Selwynianus*, the casts of *A. ramosus* and *A. Velledæ* are devoid of periodic grooves or constrictions and their test is finely ribbed. Casts of *A. subalpinus* and *A. diphylloides* are impressed by transverse furrows at distant intervals, but in these species the radiating striæ of the test and the furrows beneath it are not developed on the siphonal edge into the beak-like processes which are characteristic of *A. Selwynianus*.

Ammonites Indra, Forbes.

Plate 13, figures 2 and 2*a*.

Ammonites Indra, Forbes.—Trans. Geol. Soc., Lond., 1846, Vol. VII. p. 105. pl. 11, fig 7.
" " " Stoliczka Cret. Ceph. of S. India, p. 112, pl. 58, fig. 2.

The exquisitely preserved Ammonite figured on plate 13 was found by Mr. Richardson imbedded in a large concretion or nodule from the Middle Shales (Division D.) of the North-West side of Hornby Island, in the summer of 1871. The shell is rather more than five inches in diameter, and although its siphonal lobes and saddles are everywhere covered by the test, it is in much better condition than any of the Indian specimens of *A. Indra* described by Forbes or Stoliczka, with whose characters it agrees in every essential particular. The faint transverse furrows of the surface are, perhaps, proportionally more distant in the Hornby Island Ammonite than they are represented to be in Stoliczka's figures of *A. Indra*, but this is doubtless only an individual peculiarity.

The detached fragment from which figure 2*a* of plate 13 was drawn was broken out of the same argillaceous nodule as the Ammonite, and probably once formed part of the shell of the latter. If this supposition be correct, it would appear that the outer lip of the adult shell when perfect bore a simple, elongated and rather narrowly rounded lobe or ear on each side.

Two very small Ammonites, collected by Mr. Richardson on the South-West side of Denman Island, in Division B, the largest of which is less than three-quarters of an inch in its greatest diameter, are believed to be also referable to *A. Indra.*

Group IV.—Macrocephali, Von Buch.

Sub-genus Stephanoceras, Waagen (Pars.)—Geognostich-Palæontologische Beitrage, Von Dr. E. W. Benecke, Munchen, 1869, Vol. II., p. 248.

Ammonites complexus, var. Suciensis, Meek.

Ammonites complexus, var. *Suciensis*, Meek.—Proc. Ac. Nat. Sc., Phil., 1861, Vol. XIII., p. 317. Bul. Geol. and Geogr. Sur. of Terr., Vol. II., No. 4, p. 369, pl. 5, figs. 2, 2*a*, *b* and *c*.

Ammonites Brewerianus, Gabb (Pars.) —Pal. Cal., Vol. I., pl. 27 and pl. 28, fig. 19, but not those figured under the same name on plate 10 of the same volume.

Ammonites complexus of Hall and Meek, from the Cretaceous deposits of the Upper Missouri country and Atlantic coast, was described from small and imperfect specimens, and the characters of the species are very imperfectly ascertained. In reference to the very similar Ammonite from Comox and the Sucia Islands, Mr. Meek remarks—"After a careful comparison I am left in doubt whether it should be regarded as a variety of *A. complexus* (Hall and Meek) or as a distinct species." "It certainly is a much more compressed shell; the volutions of *A. complexus* being nearly twice as wide transversely as from the dorsal to the ventral side, while these two diameters of the whorls in the form before me are nearly equal." "Differences of this kind, however, are not generally reliable as a means of distinguishing species in this group; though the few specimens yet brought from Nebraska, as well as those found in New Jersey, do not shew any essential variations in this respect."* This

* Bulletin of the Geological and Geographical Survey of the Territories, Washington, 1876, Vol. II., No. 4, p. 369.

question cannot be satisfactorily solved until more perfect examples and a larger series of the typical *A. complexus* are obtained.

The specimens collected by Mr. Richardson, which belong to the variety *Suciensis*, are as follows:—

1. A very perfect and typical example, from the Sucia Islands, in Division A. It measures nearly four inches in its greatest diameter, and corresponds exactly in septation, shape and surface markings with the smaller of the two individuals figured by Meek on plate 5 of Vol. II., No. 4, of the Bulletin of the Geological and Geographical Survey of the Territories. Its sculpture is much like that of the type of *A. complexus*, but its whorls are much more compressed at the sides. In this latter respect it accords perfectly with the characters of the variety *Suciensis* as defined by Meek.

2. A large cast from Division A, at North-West Bay, V. I., which measures rather more than six inches across. The inner whorls are crushed and imperfect, and only a few vestiges of the septation can be traced. Near the umbilical margin the elongated nodes on the longer ribs are almost obsolete, and the ribs themselves, though perhaps a little fainter on the periphery than on the sides, are yet prominent enough to decidedly interrupt the outline of the shell at its circumference. This fossil is almost certainly conspecific with the large Vancouver Island Ammonite represented by Mr. Gabb on plate 27 of the first volume of the Palæontology of California as *A. Newberryanus*, although in the figure there given the ribs do not break the general contour of the shell. Both have the subglobose form, the comparatively small umbilicus, with its slopingly convex sides, and the entire absence of the periodic arrests of growth which distinguish *A. complexus*, var. *Suciensis* from the true *A. Newberryanus*. The ramifications of the lobes and saddles in the shell figured by Mr. Gabb also are far more complex than they are in the type of *A. Newberryanus*, and, in fact, they are more numerous and crowded than they are represented to be in Meek's figure of *A. complexus*, var. *Suciensis*. In 1875 Mr. Meek kindly sent the writer photographs of the original drawings of the types of the whole of the species described by him from Vancouver and the Sucia Islands, for comparison with Mr. Richardson's specimens. A careful study of both led to the opinion already expressed, which was communicated to Mr. Meek on the 29th of August, 1876, before his last paper on these fossils had been received, but rather more than three weeks after the date of its publication. In a letter, dated Afton, Virginia, September 8th, 1876, Mr. Meek replied as follows: "Not having the California reports at hand, I am unable to

give you any reliable information in regard to the shells referred by Mr. Gabb to *Ammonites Newberryanus* and *A. complexus*, var. *Suciensis*. I remember, however, that I have stated, in my little report on the North-West Boundary and Vancouver Fossils, that *A. Newberryanus* of Gabb is not the form described by me under that name. Mr. Gabb also arrived at the same conclusion after the publication of his report. It is quite probable, as you say, that his *A. Newberryanus* may be my *A. complexus*, var. *Suciensis*."

3, 4, 5 and 6. Four specimens from the banks of the Trent River, V. I., in Division B, one from above and three from below the falls. Two are about four inches in diameter, and these, though tolerably perfect, are somewhat distorted and have much of the sculpture obliterated, as well as some of the finest ramifications of the sutures. The others are about half that size, and one of these has the siphonal lobes and saddles beautifully preserved, as well as part of the test. The septation of all four, as far as it can be traced, appears to be exactly like that of Meek's type of *A. complexus*, var. *Suciensis*, with which they seem to agree also in all the essential characters, though they present the following unimportant variations from Nos. 1 and 2:—They are decidedly more globose; the height of their apertures, outside of the emargination, being less than the width, in which respect they approach nearer to *A. complexus* proper; the ribbing is also somewhat stronger than is usual in shells of that size and the ribs curve forwards on the periphery in a series of shallowly convex arches; whereas, in No. 1, at least, they cross the siphonal edge in almost a straight line. At first sight, too, the surface seems to be marked by periodic thickenings of the shell, or by corresponding constrictions or grooves on the cast, which appear to be placed at short but regular intervals. When more closely examined into this appearance is seen to be due to the fact that the ribs which proceed from the umbilicus are broader and higher than those which become obsolete before reaching its margin, and that between each pair of the former there are from two to five of the latter.

These four Ammonites from the Trent River are almost certainly conspecific with the *A. Deccanensis* of Stoliczka.

Group 5.—Ligati, D'Orbigny.

Sub-genus Perisphinctes? Waagen.—"Geognostich-Palæontologische Beitrage," Von Dr. E. W. Benecke, Munchen, 1869. Vol. II., p. 248.

Ammonites Newberryanus, Meek.

Plate 14, figs. 1 and 1*a*.

Ammonites Newberryanus, Meek.—Trans. Alb, Inst., 1857, Vol. IV., p. 47.
" " Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4, p. 367, pl. 4, figs. 3, 3*a* and 3*b*.

Comox, V. I., Meek. Middle Shales, Division D, North-West side of Hornby Island, one specimen; J. Richardson, 1871. Lower Shales, Division B, of Brown's River (one), and lower part of the Trent River (two), V. I.; also South-West side of Denman Island (one); J. Richardson, 1871. Productive Coal Measures, Division A, from North-West Bay, V. I., J. Richardson, 1873, ten specimens; and from the Sucia Islands (six do.); J. Richardson, 1874. Most of these are casts; but two individuals from the Sucia Islands have the pearly inner layer of the test beautifully preserved, and a specimen from North-West Bay shews the porcellanous outer layer also.

Although typical and well preserved examples of this and the preceding species may be distinguished from each other without much difficulty by the help of Mr. Meek's descriptions and figures, it is by no means easy to identify water-worn or imperfect specimens of either, and aberrant or partly intermediate varieties occur, which are very puzzling.

The characters by which *A. Newberryanus* can be most readily separated from *A. complexus*, var. *Suciensis*, are four in number, and these may be briefly stated as follows:—

1. The lobes and saddles of *A. Newberryanus*, especially those on or near the periphery, are shorter, smaller and much less divided than are those of *A. complexus*, var. *Suciensis*. Thus in *A. Newberryanus* the siphonal lobe has *three* principal branches on each side, and these are again divided at their summits into two or three branchlets. In *A. complexus*, var. *Suciensis*, the siphonal lobe has *four* branches on each side, and the apices of both are divided into four or five unequal, spreading branchlets.

2. Nearly all the specimens collected by Mr. Richardson, which in other respects correspond with the typical *A. Newberryanus*, have their whorls much more compressed laterally than is the case with *A. complexus*, var. *Suciensis*. Their dorso-ventral diameter exceeds their width by

about one-third, and the shape of their aperture, apart from the emargination, is elliptic-ovate, the width being greatest at the base. Mr. Meek, however, says that the dorso-ventral diameter of the whorls in *A. Newberryanus* is nearly or quite equal to their transverse breadth.

3. The umbilicus of this species is proportionately wider than it is in *A. complexus*, var. *Suciensis*, and exposes more of the inner whorls.

4. Besides being regularly ribbed, the surface of *A. Newberryanus* is marked, at distant but somewhat regular intervals, by transverse, swelling rims, the remains of former lips. In a specimen not quite five inches in diameter there are seven of these in the outer whorl. They may be easily distinguished from the ribs by their much larger size, also by the circumstance that they are convex on the inner as well as on the outer surface of the test, which is evinced by the broad grooves they leave on the cast.

Of the twenty-one specimens collected by Mr. Richardson only two shew the septation at all. One of these is a water-worn cast in which many of the finest ramifications of the sutures are effaced, and the other is a fragment of a very young individual, whose lobes and saddles are partly covered by the test. Nineteen have the flattened whorls, the comparatively wide umbilicus, and the periodic arrests of growth characteristic of *A. Newberryanus*, but two large, though imperfect individuals, both from North-West Bay, V. I., differ from the rest in some rather important particulars. The whorls are not nearly so much flattened at the sides, their height and width being almost equal: the umbilicus has slopingly convex sides and the ribbing appears to be sharper than in average specimens. Still, the umbilical opening of these shells is wider than in *A. complexus* var. *Suciensis*, more of the inner whorls are exposed than in that species, and the thickening of the lip at regular intervals, (traces of which, at least, are always to be seen in the true *A. Newberryanus*) though more obscure than usual in these two specimens, is nevertheless perceptible.

Mr. Meek's description of this species leaves nothing to be desired as regards accuracy, so far as it goes, but it was based on a single worn cast not more than two inches and a quarter across, and consequently does not express the whole of the characters of the shell. When fully grown *A. Newberryanus* must have attained to a very large size, for a specimen from the Sucia Islands measures eighteen inches across, and it consists entirely of septate whorls. With an increase of age, after a certain point the ribs and other surface markings gradually become wider apart, flatter and fainter, until at last they disappear altogether. In the large Sucia

Island shell just mentioned, the outer whorl is entirely smooth, and in the previous volution to that, the ribbing is almost obsolete. The sculpture of half-grown examples of *A. Newberryanus*, the condition in which it is most frequently met with, is subject to much variation, and the single row of nodes around the umbilicus on both sides, which Mr. Meek seems to regard as one of the most marked peculiarities of the species, is often absent.

It is just possible that *A. Newberryanus* may be only a geographical variety of *A. planulatus* Sowerby, for the septation of the two shells is very similar, the whorls of both are flattened at the sides, and each have about the same number of periodical arrests of growth. The main points in which they differ are that all the ribs of *A. planulatus* become obsolete before reaching the umbilicus, which is certainly not the case in *A. Newberryanus*, and that in *A. planulatus* the ribs arch forwards on the periphery, whereas they are straight in the same region in *A. Newberryanus*. The umbilicus of *A. planulatus* is generally wider in propórtion to the shell, than is that of *A. Newberryanus*, but Stoliczka figures an Indian specimen of *A. planulatus* in which the umbilicus is not any wider than it is in Vancouver examples of *A. Newberryanus* of the same size.

Group 6.—Fimbriati, D'Orbigny.

Sub-genus Lytoceras, Suess.—Sitzungsberichte der K. K. Akad. der Wissenschaften. Vienna, 1865.

Ammonites Jukesii? Sharpe.

Plate 13, figures 3, 3*a* and 3*b*.

Ammonites Jukesii, ? Sharpe.—Description of the Fossil Remains of Mollusca found in the Chalk of England, p. 53, pl. 23, figs. 11, *a* to *e*.

" " " Pictet and Campiche. Pal. Suisse, Foss. de Ste Croix. Page 350.

Shell composed of numerous slightly involute rounded whorls; umbilicus large and open; surface finely costulate and marked with distant, nearly transverse but flexuous elevations, the remains of former lips.

Whorls seven or eight, rounded, but widest near the umbilical margin and narrowing a little towards the periphery; dorso-ventral diameter of the whorls, outside of their shallow internal emargination, rather less than the greatest width of their sides. Umbilicus wide, its margin and sides abruptly rounded; measured from suture to suture its width is rather more than half the maximum diameter of the shell; sides of the whorls fully exposed; sutures distinct. Aperture transversely reniform, fully

one-third wider than high, if measured along the median line where the emargination is deepest.

Surface finely ribbed and marked by periodic arrests of growth. The ribs are flexuous and curve distinctly forwards, they are also acute and much narrower than the concave grooves between them. Nearly all the ribs are simple but occasionally one may be seen to bifurcate near the umbilical margin, and there are very obscure traces of still finer and shorter secondary ribs intercalated between the larger one. The costation, too, though certainly minute, is still rather plainly visible to the naked eye. In each whorl there appear to be about four distinct arrests of growth. These consist of rounded elevations, which are broader and more prominent than any of the ribs, but which run almost exactly parallel with them, and which are as strongly marked on the cast as they are on the shell. The ribs, on the contrary, are too minute to leave any definite impressions on the cast. Septation unknown.

Maximum diameter, seventeen lines and a-half; width of umbilicus, from suture to suture, rather more than nine lines.

Lower Conglomerates, Division C, of Norris Rock, a small "Island about a mile S. 60° E. from Norman Point, which is the most southern part of Hornby Island"; J. Richardson, 1871. A fragment only of the inner whorls.

The above description is not intended as a specific diagnosis, but merely as a brief summary of the characters exhibited in the imperfect and immature individual represented on Plate 13. The type of *A. Jukesii* (from the Hard Chalk of the County of Londonderry, Ireland) is also a single fragment of an Ammonite, in much the same condition as the present shell, but which, Mr. Sharpe says, when perfect, probably measured five or six inches in diameter. In the figures of this specimen the inner whorls appear to be more flattened at the sides than the corresponding volutions of the Ammonite from Norris Rock are, but at present no other differences of any consequence can be pointed out between the two shells.

(HAMITES VANCOUVERENSIS, Gabb.

HAMITES VANCOUVERENSIS, Gabb.—Pal. Cal., Vol. I., p. 70, pl. 13, fig. 18.

"Vancouver Island, associated with *Ammonites Newberryanus* and other Ammonites, species undetermined."—Gabb. Not recognised in any of Mr. Richardson's collections. A large species whose septation is unknown, but which is characterized by its prominent, distant ribs, each of which bears a tubercle "on the dorso-lateral angle.")

Hamites cylindraceus ? Defrance.

Plate 14, figures 2 and 2*a*.

Hamites cylindraceus, Defr.—D'Orbigny.—Pal. Franc., Terr. Cret., Vol. I., p. 551, Atlas, pl. 136.

Sucia Islands, in Division A.; J. Richardson, 1874.

A single specimen whose sculpture seems quite different to that of *Hamites Vancouverensis*, and which if not specifically identical with the *H. cylindraceus* as figured and described in the Paléontologie Française, and as since characterized by Pictet, cannot at present be distinguished from it. One side of both limbs of the fossil is worn away, and although the sculpture of a large portion of the test is well shewn, as are most of the details of the septation, still the specimen is not in a condition for the species to be determined with much certainty. Its faint, close set, equal ribs, which neither bifurcate nor bear tubercles, and more especially its septation, even to the shape and relative size of its smallest auxiliary lobes and saddles, are both almost exactly similar to those of *H. cylindraceus*.

Ptychoceras Vancouverense. (N. Sp.)

Plate 14, figures 3 and 3*a*.

Several specimens of the anterior, and apparently nonseptate, half of a Ptychoceras or Diptychoceras were collected by Mr. Richardson in 1871, from the Lower Shales, (Division B.) on the banks of the Trent River, V. I., above the falls. These for the most part consist of nearly the whole of the last limb and part of the last but one, with the elbow or shoulder which connects them. Immediately at the bend the limbs are scarcely two lines apart at their inner margins, and at a distance of rather more than an inch from it they touch each other. The outline of a transverse section of either limb is ovately-orbicular in most specimens, the anti-siphonal side being wider than the siphonal, but in some it is oval or ovate. The original of figure 3a, on Plate 14, appears to be a fragment of the central part of the penultimate limb, for the ribbing of the narrowest end is quite transverse, and that of the larger extremity nearly so.

The sculpture varies somewhat in different individuals and in different parts of the same shell. Both limbs are more or less strongly ribbed on the periphery and sides, but their inner surface is quite smooth. In the middle of the penultimate limb the ribs are transverse, but at and near

the shoulder or bend they are oblique; whereas on the last limb all the ribs are transverse. They are always most strongly marked at the point farthest from the aperture, and almost disappear just before reaching it. Thus, in the centre of the penultimate limb the surface markings appear as flattened, band-like, transverse constrictions and re-elevations, at close and regular intervals, and near the bend these gradually pass into oblique, raised and rounded rib-like folds, which are much narrower than the shallowly concave spaces between them. On the last limb the rib-like folds become fainter and more distant, until at last they fade away into a few irregularly disposed transverse raised striæ near the mouth, at a short distance from which there is a single, deeply concave, transverse groove or constriction. In some individuals the surface of the shell and cast of both limbs is also longitudinally and closely striated.

The largest specimen collected is rather more than six lines wide at the aperture, (from the siphonal to the antisiphonal side) but average examples are not wider than five lines at the same point.

The surface of *Diptychoceras laevis*, Gabb, from the "Shasta Group" of Cottonwood Creek, Shasta County, California, is said to be "plain, polished and marked only by a few extremely faint undulations," whereas in the present shell the ribs are both numerous and prominent, especially in the central portion of the penultimate limb.

This distinction may eventually prove to be only of varietal value, but for the present it will be most convenient to give the Vancouver shell a local name, as the rocks in which it is found are of later date than the Shasta Group.

Baculites Chicoensis, Trask.

Baculites Chicoensis, Trask.—Proc. Cal. Ac. Nat. Sc, 1856, p. 85, pl. 2, fig. 2.
" " Gabb.— Pal. Cal., Vol. I., p. 80, pl. 14, figs. 27, 29 and 29*a*, and pl. 17, figs. 27 and 27*a*.
Baculites inornatus, Meek.— Proc. Ac. Nat. Sc., Phil., 1861, Vol. XIII., p. 316.
Baculites Chicoensis, Trask?—Meek, Bul. Geol. & Geogr. Surv. of Terr., Vol. II., No. 4, p. 364, pl. 4, figs. 2 and 2*a*, *b*, *c*.

Vancouver and Sucia Islands, Meek. Lower Shales, Division B, of the south-west side of Denman Island. Productive Coal Measures, Division A., of the Sucia Islands (very abundant), and below Dodd Narrows, V. I. J. Richardson, 1872-75.

Baculites occidentalis, Meek.

Baculites ovatus (Say?) Meek.—Trans Alb. Inst. 1857, Vol. 4, p. 48.
" *occidentalis*, Meek. —Proc. Ac. Nat. Sc., Phil., 1861, Vol. XIII., p. 316.
" " " Bul. Geol. & Geogr. Surv. of Terr., Vol. II., No. 4, p. 366, pl. 4, figs. 1, 1*a*, *b*.

Sucia Island, Meek. North-west side of Hornby Island, in Division D; J. Richardson, 1872.

A somewhat numerous series of Baculites obtained by Mr. Richardson at Hornby and at the Sucia islands, shows that the characters most relied on to distinguish these two so-called species are not constant. According to Mr. Meek, the outline of a transverse section of *B. Chicoensis* (or *inornatus*) is ovate, and the shell smooth, while in *B. occidentalis* the section is subtrigonal (the antisiphonal side being flattened) and the surface is undulating. Almost every intermediate gradation can be observed between shells with an ovate and those with a subtrigonal section, and further, it is not unusual to find specimens combining a smooth surface with a subtrigonal section, or a coarsely undulated test with an ovate section.

(Baculites compressus, Say.

Baculites compressus, Say. —1821, Am. Journ. of Sc. & Arts, Vol. II., p. 41.
" " Morton. —1834, Syn. Org. Rem. Cret. Gr. of U. S., p. 43, pl. 9, fig. 1.
" " Hall and Meek.—1854, Mem. Am. Ac. Arts & Sc., Boston, Vol. V., N. S., p. 400, pl. 5, fig. 2, and pl. 6, figs. 8 and 9.
" " Meek. —1876, Rep. Inv. Cret. and Tert. Foss. U. Miss. Co., p. 400, pl. 20, figs. 3*a*, *b*, *c*.

Baculites compressus is included by Mr. Etheridge in his list of Comox and Valdez Inlet fossils, but it has not been recognized in any of Mr. Richardson's collections, unless it is the same as one or both of the two preceding species or so-called species of Baculite, which is not at all unlikely.)

GASTEROPODA.

Surcula Suciensis. (N. Sp.)

Plate 15, figures 1, 1*a*.

Shell small, narrowly fusiform, very long and slender; spire elongated, turreted, nearly as long as the body whorl; beak attenuated, slightly curved. Whorls nine, those of the spire very gently convex, the lowest

ones subangular near the middle; suture rather indistinct. The three apical whorls are conical, and increase rather rapidly in width; the succeeding ones are more cylindrical, and widen much more gradually. Body whorl not quite half as wide as long; shallowly concave next the suture, at a short distance from which there is a blunt angle or shoulder, gently convex above the middle and rapidly narrowing below into a somewhat curved beak, which is much shorter than the spire. Outer lip with a broad, shallow sinus next the suture.

Surface ornamented by a minute net-work, produced by very numerous, crowded and minute impressed lines, and by equally numerous raised, flexuous, transverse striæ, which are parallel to the outer lip of the shell. In the penultimate whorl there are sixteen or seventeen revolving lines, which are placed at rather unequal distances, and both these and the transverse striations are so small as to be barely visible to the naked eye. Viewed at a short distance, without a lens, the surface has a shining, silky and almost pearly aspect.

Suci Islands, in Division A.; J. Richardson, 1874. Four or five exquisitely preserved and almost perfect specimens.

The genera of *Pleurotomidæ* are very loosely and inaccurately defined, and it is generally admitted that the whole group needs revision. Until this has been done the proper position of the present species must be doubtful, though it seems to agree better with the characters of *Surcula* as now understood than with those of any other genus. It can scarcely be a *Pleurotoma* (or *Turris*), if either of these names is restricted to the large tropical or subtropical species, such as *P. Babylonica*, which have a deep and narrow infrasutural slit on the outer lip.

Surcula raricostata, Gabb, var.

Plate 15, figures 2, 2*a*.

Turris (sub-genus *Drillia*) *varicostata*, Gabb.—Pal. Cal., Vol. I., p. 93, pl. 18, fig. 47.
Surcula raricostata, Gabb ("*varicostata*, typogr. err.")—Id., Vol. II., p. 217.
Perhaps = *Fusus Renauxianus*, D'Orbigny.—Pal. Franc., Terr. Cret., Vol. II., p. 339, Atlas, pl. 223, fig. 10.

Middle Shales, Division D, West side of Hornby Island, one nearly perfect example; also Productive Coal Measures, Division A, of Nanaimo River, V. I., two and a half miles up, a single fragment; J. Richardson, 1872.

The Hornby Island specimen is rather more slender and less angular than the Californian types of *S. raricostata*, but the resemblances

between them are too close to admit of their separation into two species. The outer lip of the shell represented on plate 15 is broken, but its contour is plainly indicated by the lines of growth. Besides the distant, oblique, but nearly transverse ribs, the surface of the body whorl is finely striated across, and under the lens each of the striæ is seen to be curved concavely backwards near the suture so as to form a broad, shallow sinus. In the middle or a little above the middle of the last whorl, the striæ arch gently forwards, and below this they gradually straighten until they reach the base. Mr. Gabb makes no mention of these striæ of growth in his description of *S. raricostata*, and they are not represented in his figures of the species, so that it is to be presumed that they can only be seen in well preserved specimens. The minute curved lines of growth, and more especially the shallow sinus of the outer lip, appear to be the only characters by which this shell can be discriminated from the *Fusus Renauxianus* of the "Paléontologie Francaise," and these may not have been visible on D'Orbigny's specimens, which are not always as perfect as the figures might lead one to suppose.

Fulguraria Navarroensis, Shumard. (Sp.)

Plate 15, figures 3, 3*a*.

Volutilithes Navarroensis, Shumard.—Proc. Bost. Nat. Hist. Soc., 1861, Vol. VIII, p. 192.
" " Gabb.—Pal. Cal., Vol. I, p. 102, pl. 19, fig. 56.
Fulguraria Navarroensis, Stoliczka.—Gastr. Cret. Rocks of S. India, p. 86.
? = *Fulguraria elongata*, D Orb. sp.—Compare especially Stoliczka's descriptions and figures of that species in the Paleontologia Indica, Vol. II., p. 87-89, pl. 7.

Middle Shales, Division D., of the west side of Hornby Island, one fragment; Lower Shales, Division B, at Blunden Point, (one); and Brown's River, V. I., (two); Productive Coal Measures, or Division A, of the Sucia Islands, ten large, well preserved and tolerably perfect examples; J. Richardson, 1871-74.

The Texan and Californian types of *V. Navarroensis*, described by Shumard and Gabb, appear to have been either young shells which had not yet begun to form the thickened outer lip and columellar callus, or else imperfect individuals in which those parts of the shell had been broken off. The Sucia Island Volutes, on the other hand, which clearly belong to the same species, are nearly all adult specimens, with comparatively thick tests, and with the mouth characters fully developed. Their outer lip is much thickened, though it can scarcely be said to be

reflected, and is continuous above with a flat, expanded, semiovate callus, which spreads over nearly the whole of the columellar side of the mouth and sometimes covers a small portion of the last whorl but one. At the junction of the outer with the inner or columellar lip there is a rather deep and sub-angular notch or "insinuation," whose centre is exactly in a line with the suture. There are three large, prominent, oblique, spiral plaits on the columella, which are parallel with each other, and about three lines apart at their summits. The upper or posterior plait is placed near the middle of the aperture, on its inner side, and the lowest, which is the least prominent of the three, is situated half way between the posterior plait and the base of the shell. On the body whorl the surface markings consist of eighteen or nineteen revolving raised lines or narrow ridges, which are interrupted and made nodulous by their being crossed by obscure and low, but rather broad, transverse folds, and coarse striæ of growth.

F. Navarroensis is probably only a varietal form of the *Voluta elongata* of D'Orbigny and other authors, which Stoliczka places in Schumacher's subgènus *Fulguraria*. The difference between the two nominal species practically amounts to this, that in some specimens of *F. elongata* the body whorl is more constricted posteriorly than it is known to be in *F. Navarroensis*, and that the transverse ribbing or plication of the surface is strongest in the former. A glance at Stoliczka's illustrations of Indian examples of *F. elongata*, however, will be sufficient to shew that these distinctions are not much to be relied upon as affording good specific characters. Nine individuals of this species are represented on Plate 7 of the second volume of the Palæontologia Indica, and four of these are not more constricted near the suture than the Sucia Island specimens of *F. Navarroensis* are. The insinuations of the striæ of growth, too, which Stoliczka says "are inseparably connected with the posterior constriction of the whorls," are very plainly visible in most of the Sucia Island Volutes, and the transverse plications of the surface in some Indian varieties of *F. elongata*, do not appear to be much more strongly marked than they are in average American individuals of *F. Navarroensis*.

The name *Volutilithes* has been used in such a wide sense by recent writers, that it has come to have about the same significance in Palæontology as the Linnæan genus *Voluta* has in Zoology. If used at all, the former name will probably have to be restricted to a group of more or less angular and spinous Eocene species, with feebly developed columellar folds, such as the *Voluta spinosa* of Lamarck, and the *V. luctatrix* of Brander. *Voluta elongata*, *V. Navarroensis*, and a number of closely re-

lated species, on the other hand, seem to form a well marked and very natural section, or subgenus of the *Volutinæ*, more characteristic of the Cretaceous than of the Tertiary rocks, whose shells can generally be distinguished without much difficulty by their slender, fusiform shape, their spirally striated or cancellated whorls, their thickened outer lip and comparatively prominent columellar folds.

Stoliczka, as before stated, holds that the name *Fulguraria* should be applied to these shells, on the ground that they do not differ in any essential particular from the type of that genus, the *Voluta fulminata* of Lamarck, and this view has been provisionally adopted by the writer. Conrad, it is true, says that *V. Navarroensis* belongs to his subgenus *R stellites*,* but even if the correctness of this assertion be admitted, and the objection to its use, as suggesting affinities that do not exist, be waived, it still seems highly probable that *Rostellites* is merely a synonym of *Fulguraria*.

Fusus Kingii, Gabb.

Plate 15, figure 4.

Fusus Kingii, Gabb.—Pal. Cal., Vol. I., p. 85, pl. 28, fig. 204.

Sucia Islands, in Division A.; J. Richardson, 1874. Two specimens, both with most of the test preserved, but with the beaked extremity broken off. The best of these is figured, as the species was described from casts which did not shew the surface ornamentation. The sculpture consists of revolving ridges or fine rounded ribs, which are placed at unequal distances from each other, and these are crossed by crowded, minute and parallel, transverse, raised striations, also, on the angle or angles of the whorls only, by coarse distant plications. There are six or seven whorls; those of the spire are angular or subcarinated below the middle, and bear a single row of rather distant nodes or tubercles. The body whorl is concavely constricted near the middle, the constriction being bounded, both above and below, by a nodose and obtuse keel.

Serrifusus Dakotensis, var. Vancouverensis.

Plate 15, figure 5.

Fusus (Serrifusus) Dakotensis, Meek, var.—Rep. Inv. Cret. and Tert. Foss. U. Miss. Co., p. 375, pl. 32, fig. 7*a*.

Fusus (Serrifusus) goniophorus, Meek. —Idem, p. 376.

Shell large, subfusiform, angular; spire elevated, but not equal in height

* "American Journal of Conchology," Vol. I., 1865, p. 363.

to the body whorl: canal short. Whorls five and a-half or six, convex, angular, those of the spire obliquely compressed above and encircled below the middle by a narrow, very prominent, subnodose, laminar keel, beneath which they are nearly perpendicular, but slope a little inwards; sutures indistinct. Body whorl also obliquely flattened above, angular and keeled very conspicuously above the middle, ventricose, and bearing two minute keels or spiral ridges below, and finally contracting rapidly but unequally on either side into the short canal at the base. Aperture ovately subpyriform, broadly channelled in front; outer lip apparently thin and simple; pillar devoid of plaits, as far as can be ascertained; no callus on the columellar side.

The principal keel, which encircles the whole shell in a continuous spiral, is raised to a height of nearly, or quite, two lines above the highest general level of the whorls, and is subnodose, or undulated on its edge, in consequence of its being interrupted and crossed by slightly elevated transverse folds and corresponding shallow depressions, at irregular but for the most part rather distant intervals. In addition to this, the entire surface is covered by a fine and delicate network, composed of close-set minute, spiral raised lines, and of densely crowded, transverse, but somewhat flexuous striations.

Estimated length when perfect, about three inches and four lines; maximum width, one inch and not quite eleven lines.

Middle Shales, Division D, of the north-west side of Hornby Island; J. Richardson, 1872. A single specimen with the apex of the spire and tip of the canal broken off, but with a considerable portion of the test remaining, the sculpture of which is exquisitely preserved.

On pages 375-377 of his "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," plate 32, figure 7*a*, Mr. Meek has described and figured a *Serrifusus* from Dakota, which he provisionally regards as a varietal form of *S. Dakotensis*, but which he thinks may belong to a distinct, though closely allied species, for which he suggests the name *S. goniophorus*. Judging by the solitary specimen collected by Mr. Richardson, the differences between it and the Dakota shell do not appear to the writer to be sufficient to warrant their being regarded as two distinct species, but the Hornby Island *Serrifusus* is probably entitled to rank as a well marked variety, characterised principally by the much greater prominence of its revolving, spiral keel.

Perissolax brevirostris, Gabb.

Perissolax brevirostris, Gabb.—Pal. Cal., Vol. I., p. 91, pl. 18, fig. 43.

Sucia Islands, in Division A.; J. Richardson, 1874. One nearly adult and four or five immature specimens.

Littorina compacta, Gabb.

? Littorina compacta, Gabb.—Pal. Cal., Vol. I., p. 131, pl. 20, fig. 89.

Lower Shales, or Division B, of the south-west side of Denman Island; J. Richardson, 1871. Two perfect but small individuals.

Although no vestiges of any nacreous structure are apparent in the above named shells, yet, in the writer's judgment, their general appearance, thin test, and close resemblance to *Photinula*, suggest affinities with the *Trochidæ* rather than with the *Littorinidæ*. If the words "surface *smooth*," in Mr. Gabb's definition of the genus *Ataphrus*, were altered to "surface smooth or spirally grooved," the name of the present species could probably be better written *Ataphrus compactus*.

Potamides tenuis, Gabb.

Plate 15, figures 8, 8*a* and 8*b*.

Potamides tenuis, Gabb.—Pal. Cal., Vol. I., p. 130, pl. 20, fig. 86.

Middle Shales, Division D, north-west side of Denman Island, two nearly perfect and well preserved individuals. Lower Shales, Division B, south-west side of Denman Island, two small examples. Sucia Islands, in Division A., one very small and partly exfoliated specimen. J. Richardson, 1871-74.

In the description of this species no mention is made of the fine reticulation of the surface, so that it is to be presumed that Mr. Gabb's types did not show that character. In addition to the distant, elevated nodules on the angles of the whorls, the exterior of the test of *P. tenuis*, when in fine condition, is covered by a minute network, composed of crowded revolving striations, which are crossed by equally fine, transverse, flexuous striæ. A figure of the best specimen collected by Mr. Richardson has been given, as that in the Palæontology of California does not give a very good idea of the shape or sculpture of the species.

Potamides tenuis, variety Nanaimoensis.

Plate 15, figures 9 and 9*a*.

Shell turreted, very long and slender; whorls nine, increasing very gradually in size. The first five are convex, but somewhat compressed

at the sides; the sixth, seventh and eighth are also gently convex, but more or less angular or subcarinated a little below the middle. The body whorl is moderately inflated and faintly and spirally subcarinated considerably above the middle, and there is sometimes a second and smaller keel or ridge below the first. Tho aperture appears to have been obliquely subovate when perfect, and to have contracted suddenly below into a short, nearly straight, and channelled beak.

The surface is transversely ribbed and striated, and the lower whorls are also encircled by narrow, linear, revolving ridges. A large portion of the test on the body whorl happens to have been broken off in the few specimens yet collected, but on the last whorl but one the transverse ribs are distant, narrow and flexuous. On this whorl, too, and on that which precedes it, there are three rather widely separated revolving ridges above the angle, and four much more closely disposed ones below it. The summit of the angle also bears a single spiral ridge, which gives the shell a lightly carinated aspect, but the ridge on the angle is not larger nor more prominent than either of those above it. All the revolving ridges are marked by tubercles where the ribs cross them, but the tubercles are largest on the angles of the whorls.

Middle Shales, Division D, of the north-west side of Hornby Island, three specimens; also Productive Coal Measures, Division A, at Nanaimo River, V. I., two miles and a-half up, two or three imperfect examples; J. Richardson, 1871 and 1872.

The spiral keel is not very distinctly defined in any of the specimens, and in some it is almost obsolete.

This shell is probably nothing more than a local variety of *P. tenuis*, which may usually be distinguished from the typical form by its slender and more elongated shape, more evenly rounded whorls, and by the numerous elevated revolving ridges on the two last volutions. The two forms, however, seem to be connected by intermediate gradations both of shape and sculpture.

Cerithium Lallierianum, D'Orbigny. Variety Suciense.

Plate 15, figures 10 and 10*a*.

Cerithium Lallierianum, D'Orbigny.—Pal. Franc., Terr. Cret., Vol. II., p. 365, Atlas, pl. 229, figs. 7–9.

" " *Forbes.* —Quart. Journ. Geol. Soc. Lond., Vol. I., p. 352, pl. 4, fig. 10.

Sucia Islands, in Division A., six well preserved examples; also Pro-

tection Island, in rocks of the same Division, a single and not very perfect individual; J. Richardson, 1872 and 1874.

The Sucia Island variety of *C. Lallierianum* differs only from the type of the species in its more ventricose whorls and deeper sutures.

Tessarolax distorta, Gabb.

Tessarolax distorta, Gabb.—Pal. Cal., Vol. I., p. 126, pl. 20, figs. 82 & 82 *a*, *b*.

Lower Shales, Division B, of the banks of the Trent River, V. I., below the falls; J. Richardson, 1871. One imperfect specimen.

Anchura stenoptera, Goldfuss. (Sp.)

Plate 15, figures 11 and 11 *a*.

Rostellaria stenoptera, Goldfuss.—Petrefactæ Germaniæ, Vol. III., p. 18, pl. 170, fig. 6.

Productive Coal Measures, Division A, Nanaimo River, V. I., two miles and a-quarter up; J. Richardson, 1872.

A single and rather imperfect individual, which appears to be identical with the above named European species. *A. stenoptera* was originally described from the "chloritic chalk" or Upper Greensand of Westphalia, and, according to Prof. Morris, it has since been found in the Lower Chalk of Sussex.

As there are some slight differences between the specimen collected by Mr. Richardson and the shell represented by Goldfuss, it has been thought desirable to give two figures of the former.

Anchura exilis, Gabb.

Aporrhais exilis, Gabb.—Pal. Cal., Vol. I., p. 129, pl. 29, fig. 231.
Anchura exilis, Gabb. —Idem, Vol. II., p. 226.

Productive Coal Measures, Division A, of the Sucia Islands; J. Richardson, 1874. One specimen.

Amauropsis Suciensis. (N. Sp.)

Plate 16, figure 1.

Shell ovately subglobose, longer than wide; spire about one-third the entire length. Whorls four or four and a-half, those of the spire conspicuously subtruncated or excavated next the suture above, obliquely but very gently convex, and somewhat compressed laterally below; suture deeply impressed. Body whorl inflated, narrowly rounded at the

base, and more or less distinctly shouldered or excavated, but not angular above; umbilicus small, but apparently never quite closed. Aperture sub-semicircular, pointed above, longer than wide, nearly straight, or with a slight sigmoid curve on the inner side, and regularly convex on the outer.

Surface nearly smooth, but marked with minute, densely crowded striæ of growth in well preserved individuals.

Length of the largest specimen yet obtained, six lines and a-half; height of the spire, two lines and a-half; maximum width of the body whorl, about five lines.

Productive Coal Measures, Division A, of Nanaimo River, V. I., two miles and a-half up, and of the Sucia Islands; J. Richardson, 1872 and 1874. One imperfect example from the first mentioned locality, and four well preserved specimens from the second.

Gyrodes excavata, Michelin. (Sp.)

Plate 16, figs. 2 and 2*a*.

Natica excavata, Mich., D'Orbigny.—Pal. Franc., Terr. Cret., Vol. II., p. 155, Atlas pl. 173, figs. 1 and 2.
Natica infracarinata, Gabb. —Proc. Ac. Nat. Sc. Phil., 1861, Vol. XIII., p. 319.
Gyrodes Spillmanii, Gabb. —Idem, p. 320.

Shell depressed subglobose, about as wide as high, spire short, less than one-fourth the entire length. Whorls four, those of the spire obliquely and gently convex, the third being also distinctly truncate above. Body whorl truncated nearly horizontally next the suture, concavely constricted immediately below the angle, which is subacute, and swelling out widely near or a little below it; base obliquely and somewhat concavely truncated on the inner side. Umbilicus widely and deeply funnel-shaped, with a distinctly carinated margin. Aperture triangular above, pointed below, longer than wide; outer lip thin, simple, and expanded in the centre; inner lip nearly straight, but curved somewhat concavely below. The truncation of the whorls above is concave in some specimens and flat in others.

Surface polished, nearly smooth, but marked with minute, numerous, and densely arranged curved striæ of growth.

The length and breadth of a perfect specimen are almost exactly equal, the greatest diameter being about six lines and a-half in either direction; the height of the body whorl is five lines.

Middle Shales, Division D, north-west side of Hornby Island, (one);

Lower Shales, Division B, at Brown's River, V. I. (one); Productive Coal Measures, Division A., at the Nanaimo River, ten miles up, (one); and Blunden Point, V. I. (two); also at the Sucia Islands, eight or ten specimens; J. Richardson, 1871-74.

This shell, which occurs at many localities in the Vancouver Cretaceous, is believed to be a small form of the European *Natica excavata*. Mr. Tryon, who has kindly compared two of the best specimens collected by Mr. Richardson with Mr. Gabb's types of *Natica intracarinata* from New Jersey and *Gyrodes Spillmanii* from Mississippi in the Museum of the Academy of Natural Sciences of Philadelphia, agrees with the writer in referring all three to *N. excavata*. *Gyrodes Conradiana* of Gabb,* from the Chico Group of California, is also probably another variety of the present species, in which the truncation of the upper part of the whorl is obsolete. The characters given above, though generally applicable, are subject to some variation, for in a specimen of *G. excavata*, from Brown's River, V. I., the whorls appear to be evenly rounded, or nearly so, above, and the umbilical keel is barely perceptible.

Sycodes glaber, Shumard. (Sp.)

Pyrula glabra, Shumard.—Trans. Ac. Sc., St. Louis, 1858, Vol. I., p. 125.
Ficus cypræoides, Gabb. —Pal. Cal., Vol. I., (1864) p. 105, pl. 19, fig. 58.
Sycodes cypræoides, Gabb.—Idem., Vol. II., pp. 160 and 121.

Productive Coal Measures, Division A, at Protection Island (four specimens), and Nanaimo River, V. I., two miles and a quarter up (two); also, Sucia Islands, (one); J. Richardson, 1872-74. "In dark limestone at Nanaimo River, with *Nautilus Dekayi* and *Inoceramus Vancouverensis*." Shumard.

Sycodes cypræoides of Gabb is almost unquestionably the same shell as the *Pyrula glabra* of Shumard, and the latter specific name must be retained as having priority of date.

Hindsia nodulosa, Whiteaves. (Sp.)

Plate 15, figures 6 and 7.

Fasciolaria nodulosa, Whiteaves.—Geol. Survey of Canada, Rep. of Progr. for 1873-74, p. 268, pl. of fossils, figs. 7 and 7*a*, but not 7*b*.

Shell fusiform, sub-angular, about half as broad as long, spire rather more than one-third the entire length. Whorls seven, the first four more

* "Palæontology of California," Vol. I., p. 107, pl. 29, fig. 219

or less acutely conical, with obliquely flattened sides, the fifth and sixth concave above and swollen below into a prominent, narrowly rounded, nodulous, spiral ridge. Body whorl encircled in the middle by the same spiral ridge, broadly and concavely excavated above, and narrowing rather abruptly below into a stout, straight beak, whose length is nearly equal to that of the spire. Aperture ovately sub-triangular, angular or sub-angular near the middle on the outer and nearly straight on the columellar side; outer lip formed of a single flatly expanded varix, which is ribbed externally and crenulated within; inner lip encrusted, slightly convex above and straighter below, beak channelled, the channel open throughout its entire length; columella with four inconspicuous teeth or flattened tubercles at its upper end, and with three plaits or laminar teeth below. The teeth on the upper part of the columella are placed close together, the plaits or laminar teeth at its lower or anterior end, on the contrary, are comparatively far apart from each other. The first, or posterior plait, which is transverse and moderately prominent, is situated about the middle of the aperture, exactly opposite the angle of the outer lip; the second is rather more than a line in distance from the first; the position of the third, or anterior one, is not very clearly shewn, but it appears to be placed very near to the commencement of the canal. All the teeth and plaits are small, and situated so far back in the aperture that they can scarcely be seen, except in specimens in which part of the outer lip is broken away.

The entire surface is marked by numerous, simple, rounded, revolving raised lines, which are placed at varying distances apart, but which are always narrower than the flattened spaces between them. At least twenty-one of these revolving lines can be counted on the body whorl, and those below the central ridge are much larger than those above it. The spiral ridge or blunt keel, which encircles nearly the whole of the shell, is crossed, also, by distant, transverse, rounded, raised folds and corresponding depressions, but the folds are obsolete, or nearly so, both above and below the ridge, where the shell is simply striated across. The whorls of the spire, accordingly, are coronated below, and the body whorl bears about fourteen conspicuous, and transversely elongated but somewhat rounded nodes on its central blunt keel.

Two specimens of this species were collected by Mr. Richardson in 1872, one from the Nanaimo River, V. I., two and a half miles up, the other from Protection Island, both in Division A. These have been figured and briefly described in the "Report of Progress" for 1873-74, under the name

Fasciolaria nodulosa, but the apices of the spire, and the apertures of both were then completely buried in the rock, and the characters of the species were very imperfectly understood. The matrix has since been removed from both, and the spire has been found to be rather longer than it was first supposed to be; the aperture of one specimen, also, has been cleared sufficiently to expose the teeth and plaits on the columella; the presence of the latter was previously inferred from the shape and sculpture of the exterior. The outer lip of both is imperfect.

The original of figure 7 on plate 15, which was obtained by Mr. Richardson in 1874, at the Sucia Islands, from Division A., fortunately has the outer lip well preserved, and its expanded, varix-like shape shows that the shell belongs to the *Tritoniidæ*, rather than to the *Fasciolariinæ*.

There is no necessity for changing the specific name "*nodulosa*," although it was previously applied to a Miocene *Fasciolaria* from North Carolina by Dr. Emmons, in 1858, for the present species is almost certainly a *Hindsia*, in the sense in which that genus is now accepted by most palæontologists.

Cirsotrema tenuisculptum. (N. Sp.)

Plate 16, figures 3, 3*a*, 3*b* and 3*c*.

Shell elongate-conical; spire turreted, about equal in length to the body whorl; test thin. Whorls seven, those of the spire convex, with deep sutures; body whorl ventricose, with a small umbilical perforation at its base; aperture unknown.

Surface marked by minute, flattened, revolving ridges, which have a beaded aspect when viewed under a lens, in consequence of their being crossed by still more minute and crowded, transverse, raised lines. The revolving ridges are unequal in size, some being both broader and higher than others, but the larger ones are most numerous on the lower part of the upper whorls and on the middle of the last volution. There are about twelve of these ridges on the last whorl but one, five of which are larger than the rest, and on the body whorl there are about thirty, ten of which are comparatively large, and the remainder small. The transverse, raised lines extend from suture to suture. Near the middle of the outer whorl there is a narrow, very slightly elevated, transverse varix, or arrest of growth, which marks the position of a previous outer lip and to some extent indicates its outline.

Length of the only specimen not quite six lines; maximum convexity of the body whorl rather more than three lines.

Sucia Islands, in Division A.; J. Richardson, 1874.

Scalaria (Opalia) Mathewsonii, Gabb.

Scalaria (*Opalia*) *Mathewsonii*, Gabb.—Pal. Cal., Vol. I, p. 212, pl. 32, fig. 278.
Compare *Scalaria pulchra*, Sowerby.—Trans. Geol. Soc., Lond., 1836, series 2, Vol. IV. p. 343, pl. 18, fig. 11; and Geol. Mag., Lond. N. S., Vol. III., p. 109, pl. 3, fig. 14.

Productive Coal Measures, Division A., of the Sucia Islands; J. Richardson, 1875. An imperfect specimen with only parts of the test preserved, and with no indications of the basal carina remaining.

Margarita ornatissima, Gabb. (Sp.)

Angaria ornatissima, Gabb.—Pal. Cal., Vol. I., p. 121, pl. 20, fig. 78.

Middle Shales, Division D, north-west side of Hornby Island (one specimen.) Productive Coal Measures, Division A, of the Sucia Islands, abundant, perfect and well preserved; J. Richardson, 1872 and 1874.

This species is one of the most frequent and characteristic fossils of the Cretaceous rocks of the Sucia Islands. In the writer's judgment, it is a very typical *Margarita*, and Mr. W. H. Dall, who has seen the specimens, is of the same opinion.

Stomatia Suciensis. (N. Sp.)

Typical form, plate 16, figure 4. Variety *carinifera*, plate 16, figure. 5.

Typical form.—Shell subovate, longer than wide, pointed above and more or less narrowly rounded below; spire short, about one-fifth the entire length. Whorls four, increasing very rapidly in size, convex, oblique; sutures distinct. Spire turbinate conical; body whorl very oblique, moderately inflated, devoid of any umbilicus or umbilical depression, sometimes subangular near the base. Aperture ovate, longer than wide, pointed above and rounded below; outer lip thin, simple, gently convex; inner lip concave.

The surface of the last whorl is marked with rather fine, rounded, revolving ribs, which are wider than the impressed lines between them, and by coarse, irregularly disposed, transverse striæ of growth, some of which, in one specimen at least, are developed into nodular folds near the base of the shell.

Variety carinifera.—Shell wider than high; spire extremely low; body whorl obliquely compressed above, angulated below the middle,

and encircled with from one to four revolving keels in addition to the spiral ribs.

Sucia Islands, in Division A.; J. Richardson, 1874. Fourteen good specimens. Five of these belong to the typical form of the species and five to the variety *carinifera*, but the remainder, all of which are very small shells, form a connecting link between the two extremes, being wider than high as in the keeled variety, but resembling the type in the want of a prominent angle below the middle of the body whorl and in not being encircled by any revolving carinæ. The typical form grows to a considerable size; the largest individual (the original of figure 4, on plate 16), when perfect, was probably two inches and a half in length, but the largest example of the keeled variety yet obtained is not more than eight lines long. The large specimens, also, have had their original shape much altered by pressure.

It would seem that this is the only true *Stomatia* at present known from rocks of Cretaceous age. *Stomatia gaultina* of Pictet and Roux has been removed from that genus by Pictet & Campiche, and placed in *Neritopsis*, while the *Stomatia aspera* of D'Orbigny (Pal. Franc., Terr. Cret., Vol. II., p. 237, pl. 188, fig. 4–7) is almost certainly a *Catinus*.

Anisomyon Meekii, Gabb ? var.

Anisomyon Meekii, Gabb.—Pal. Cal., Vol. 1, p. 142, pl. 21, fig. 105.

Shell conical, moderately elevated, sides sloping obliquely in all directions, neither concave in front nor convex behind; base ovately-orbicular, a little longer than wide; apex acute, nearly erect but with a very slight inclination towards the posterior end, and situated a little in advance of the middle. Surface apparently marked with crowded concentric striations; muscular scars not visible.

Lower Shales, Division B, of the banks of the Trent River, V. I., above the falls; J. Richardson, 1871. Two large but imperfect and badly preserved casts, also a small but more perfect specimen with the test partly exfoliated.

On the posterior slope of the smaller of the two casts, a mesial carina runs from the apex to the base, as in the *Anisomyon borealis* of Meek and Hayden,* but no such keel is perceptible in the other two specimens. In the typical *A. Meekii*, from the Shasta Group of California, the apex

* See Meek's Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country, p. 288, pl. 18, fig. 9.

appears to be a little more hooked than it is in the *Anisomyon* from Vancouver Island, but at present no other appreciable difference can be noted between the specimens from these two localities.

Acmæa. (Sp. undt.)

Plate 16, figures 6 and 6*a*.

Compare *Acmæa Tejonensis*, Gabb.—Pal. Cal., Vol. II., p. 172, pl. 28, fig. 56.

Shell depressed conical, sides sloping obliquely and regularly in all directions; outline of base elliptical, but perhaps a little wider anteriorly than posteriorly; apex sub-central, situated slightly in advance of the middle, apparently conical and erect, not curved distinctly forwards. In a cast of the shell, when examined with a simple lens, the apex appears to be divided into two nearly equal halves by a minute, short, transverse, groove, and the anterior half is seen to be marked by two equally small and short longitudinal ridges. On the interior of the test, when viewed in the same way, a minute, transverse tubercle can be detected, which probably causes the transverse division of the apex visible in the cast, but the markings of the interior, which correspond to the longitudinal ridges on the anterior half of the cast of the apex, cannot be clearly made out.

On each side of the interior of the test and of the outer surface of the cast there is a curved, oblong, muscular scar, whose outline is very similar to that of a bean, except that it is obliquely truncated behind. At the posterior end these two scars are distinctly connected by a nearly straight, rather broad band, which unites with the inner half of their truncated ends. In front, also, the two lateral scars seem to be connected, but very obscurely, by an ill-defined, narrow, irregular, but somewhat semielliptical line of attachment either of the muscles or of the mantle.

The sculpture of the exterior is unknown, and the outer surface of the apex has not been seen, but radiating and rather broad bands of colour are more or less visible on the interior of the test.

Nanaimo River, V. I., two miles and a quarter up, in Division A; J. Richardson, 1872. A single specimen, broken into two halves, in one of which the whole of the interior of the shell is exposed, the outer surface being covered by rock, while the second is a beautifully preserved cast of the first.

It is quite likely that the fossil above described may be an adult individual of *Acmæa Tejonensis* Gabb, but until its characters are better known

it would be useless to speculate on its possible specific relations. Its muscular scars are very different to those of *Anisomyon alveolus* of Meek and Hayden, which it closely resembles in other respects.

Cinulia obliqua, Gabb.

Cinulia obliqua, Gabb.—Pal. Cal., Vol. 1, p. 111, pl. 19, figs. 64, 64*a*, *b*, *c*.

Middle Shales, Division D, of the north-west side of Hornby Island. Lower Shales, Division B, of the south-west side of Denman Island. Productive Coal Measures, Division A, at Nanaimo River, V. I., two and a-half miles up, at Protection, Gabriola and Salt Spring or Admiralty Islands, also at the Sucia Islands. Apparently the most abundant gasteropod of the Nanaimo and Comox coal fields, as it was met with in almost every locality examined by Mr. Richardson.

Cinuliopsis, New Genus.

Shell like that of *Cinulia*, Gray, as recently re-defined by Meek,* but with the aperture distinctly notched or rather deeply sinuated in front, also with the outer lip not thickened externally.

The affinities of this genus are at present doubtful. Its proper place may possibly be in the family *Ringiculidæ*, between *Ringicula* and *Cinulia* proper, but the emargination of the aperture in front, which indicates the probable existence of a respiratory siphon or siphonal fold in the animal, seems to point to a nearer relationship with the *Siphonostomata* than with the *Holostomata*. In *Cinulia* the anterior margin of the aperture is entire or nearly so, and the outer lip is much thickened.

Cinuliopsis typica. (N. Sp.)

Plate 16, figures 7, 7*a* and 7*b*.

Shell ovately subpyriform, spire very short; body whorl ventricose in the middle and narrowing somewhat rapidly below. Aperture elongated, much longer than wide, broadly convex on the outer and nearly straight on the inner side. Columellar lip spreading into a thick, broad, rounded callus above, contracted in the middle, narrow and produced below. Columella bearing a single, rather prominent and very oblique spiral fold near its anterior termination, into which it ultimately merges. Outer lip simple, continuous with the columellar callus above, deeply channelled and emarginate at its junction with the columella below. When the shell

*Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country, p. 283.

is placed with its aperture downwards, the canal is seen to be obliquely recurved, and its previous position is indicated by an oblique groove, bounded above by a raised, rounded ridge, both of which take their rise from the outer margin of the columella, a little below the middle of the aperture. The groove leads directly into the channel, while the ridge, which bounds both on one side, terminates at the base of the outer lip.

The surface is marked by squarely cut, revolving grooves, and by minute, crowded, transverse striations. On the body whorl there are about fourteen or fifteen spiral grooves, those in the central portion being about as wide as the interspaces, while those near the suture above and base below are almost invariably wider than the spaces between them.

Productive Coal Measures, Division A., of the Sucia Islands; J. Richardson, 1875. A nearly perfect specimen in very good condition. The apex is broken off, so that it is impossible to say whether the spire was obtuse or abruptly acuminate, but there can be no doubt that it was extremely short.

Haminea Horni, Gabb? var.

Plate 16, figures 8, 8*a* and 8*b*.

Bulla Hornii, Gabb.—Pal. Cal., Vol. I., p. 143, pl. 29, fig. 235.

Middle Shales, Division D, of the north-west side of Hornby Island. Lower Shales, Division B, of the south-west side of Denman Island. Productive Coal Measures, or Division A, at Blunden Point, and two miles and a quarter up the Nanaimo River, V. I., also at Vesuvius Bay, Admiralty Island, and at the Sucia Islands. J. Richardson, 1872-75.

Fifteen or sixteen well preserved specimens of a small species of *Haminea*, which seem to possess essentially the same characters as the Tejon fossil described by Mr. Gabb as *Bulla Hornii*. In addition to the "very fine, impressed, revolving lines" by which the surface of that shell is said to be marked, the test of the best specimens collected by Mr. Richardson is densely and very finely striated transversely, and the impressed lines, under a simple lens, are seen to consist of continuous, rounded punctures. When still more highly magnified the lines appear to be regularly crenate on both sides, as shown in the figure.

The length of the largest specimen is not more than four lines.

Dentalium Nanaimoense, Meek.

Plate 16, figures 9, 9*a*, and 9*b*.

Dentalium Nanaimoense, Meek. —Trans. Alb. Inst., Vol. IV., (1857) p. 44.

" *Koomooksense*, Meek. —Bul. Geol. & Geogr. Surv. of Terr., Vol. II., No. 4, p. 364, pl. 3, fig. 6.

?= *Dentalium stramineum*, Gabb. —Pal. Cal., Vol. I., p. 139, pl. 21, fig. 101.

Compare *Dentalium gracile*, Hall & Meek.—See Meek's Rep. Inv. Cret. and Tert. Foss. of the U. Miss. Country, p. 266, pl. 18, figs. 13, *a*, *b*, *c*, *d*.

Also, *Dentalium decussatum*, Sowerby. —Especially as described and figured by J. Starkie Gardner in the Feb. No. 1878, of the Quart. Journ. of the Geol. Soc. of London.

Denman Island, south-west side, in Division B. Two miles and a-quarter up the Nanaimo River, V. I.; also Admiralty Island and the Sucia Islands, in Division A.; J. Richardson, 1872-75.

Dentalium Nanaimoense was described from a fragment of the anterior portion of the shell not much more than half an inch in length, and the species has since been found to taper much more gradually than it is represented as doing in Meek's partly restored figure. Although none of the specimens collected by Mr. Richardson are perfect, especially at the larger end, yet some of them are more than an inch long, and the relative width of fragments of both extremities seems to indicate that the shell attained to a length of two inches or more. It is slightly curved and very slender, the apical portion in particular being extremely narrow and attenuated. The thickness of the anterior end of the largest individual yet obtained is not much more than two lines. In a specimen fourteen lines long, from the Sucia Islands, the apex, which is imperfect, is about a quarter of a line in diameter, and the anterior end rather more than a line, but others are more robust. The longitudinal ribs commence at the apex and extend to within a very short distance of the mouth. In the original of figure 9*b*, on plate 16, there are about sixteen costæ near the smaller end, and at the opposite extremity they have increased to double that number by the intercalation of a shorter rib between each pair of the longer ones. The test is moderately thick, and the transverse striæ are extremely faint and disposed at rather irregular intervals.

Mr. Meek says, "This species is nearly related to *D. gracile*, of Hall and Meek, from which it may be distinguished by its thinner shell and

more slender form, as well as by its less distinct lines of growth." Both shells, however, were described from imperfect specimens, and under the circumstances, these differences, which after all are only differences of degree, are perhaps not much to be relied upon for the discrimination of closely allied species. Meek's latest description of *D. gracile* would apply almost equally well to *D. Nanaimoense*, and the same may be said of the brief diagnosis of *D. stramineum* in the first volume of the Palæontology of California, though it is only fair to both writers to add that they may have had reasons for regarding their species as distinct from the present, which are not fully stated in their definitions of the former. It is by no means improbable, too, that *D. gracile*, *D. Nanaimoense* and *D. stramineum* are only geographical and varietal forms of the *D. decussatum* of Sowerby.

Entalis Cooperi, Gabb. (Sp.)

Plate 16, figures 10 and 10*a*.

Dentalium Cooperi, Gabb.—Pal. Cal., Vol. I., p. 139, pl. 29, fig. 100.

Shell, when full grown, very large, slightly curved; section circular or nearly so; test extremely thick in the middle and at the smaller end. Surface marked by a faint and very minute reticulation, barely visible to the naked eye, and produced by minute, parallel, transverse grooves or annulations, which are crossed at right angles by still finer and fainter, longitudinal, impressed lines. In very young specimens the test is quite thin and the reticulation of the surface is barely perceptible, even when examined with a lens.

North-west side of Hornby Island, in Division D; two miles and a quarter up the Nanaimo River and lower part of the Trent River, V. I., in Division A; J. Richardson, 1872 and 1873. The specimens from the Trent River show that the species must have been very large when perfect, for one shell from this locality, the original of figure 10 on plate 16, measures more than three inches and three-quarters in length, and wants nearly three-quarters of an inch of the smaller end. Nearly all the large specimens are much distorted by pressure, but in a single fragment of the posterior half of the shell, an inch and three-quarters long, which seems to have preserved its normal shape, the small end is fully two lines in diameter and the large nearly four. At the posterior end, therefore, the diameter of the shell appears to become doubled in a length of two inches, but the rate of increase towards the anterior end of adult shells seems to have been less rapid.

LAMELLIBRANCHIATA.

Teredo Suciensis. (N. Sp.)

Plate 17, figures. 1, 1*a*.

Shell globosely cordate; valves very inequilateral, slightly longer than high; test thin. Anterior side short; anterior auricle convex above, pointed in front, truncated almost horizontally below, variable in size, but usually very small. In six out of seven specimens the anterior auricle extends from the beaks to one-third the distance from the extremity of the ventral border, but in the seventh it reaches as far downwards as the middle of the front margin of the valves. Anterior hiatus, as viewed in front, inversely triangular, higher than wide in the majority of specimens, but in one instance only, wider than high. Margin of the valves, as viewed laterally, truncated almost perpendicularly, but a little obliquely, beneath the anterior auricle. Base obtusely pointed, posterior side longer than the anterior, nearly straight above, narrowing obliquely and concavely from the base upwards, gaping rather widely in its lower half and forming a bluntly pointed or narrowly rounded junction with the cardinal margin above. Umbones prominent, placed in advance of the middle; beaks incurved and directed a little forwards.

The valves are divided into three subordinate areas, each of which has its own peculiar shape and style of sculpture. The first of these is the anterior auricle, whose surface is covered with densely crowded and exceedingly minute, concentric striæ which can only be seen by the aid of a lens. The second is the central area, which is very narrow and invariably marked by minute radiating striæ barely visible to the naked eye. Its upper portion lies between the posterior area and the anterior auricle, from which latter it is sometimes separated by an impressed line or slight shoulder, and below the auricle it occupies the narrow space between the posterior area and the front margin of the valves. It is widest in the middle and diminishes very gradually in size both above and below. The third, or posterior area, is much larger than the two others combined and includes the whole of the shell behind the central area. Two very faint, shallow grooves, with a small and equally faint, linear rib between them, extend obliquely from the beaks to the middle of the pointed base, and these together form the front boundary of the posterior area and mark its separation from the central space. The

sculpture of the posterior area consists of concentric, raised striæ or fine ribs, which follow the curved outline of the shell, and in doing so bend downwards, and again a little upwards at an obtuse or somewhat rounded angle in crossing the farthest of the two grooves from the central space. In some specimens the raised striæ on the posterior area are much wider than the spaces between them, and the surface of these may fairly be called ribbed, but even in those individuals which are most finely striated the striæ on the posterior area are always perceptibly coarser and farther apart than they are on any other part of the shell.

Burrows cylindrical, lined with a calcareous tube, which is variously bent or curved when the shell is immature, but which becomes nearly straight when the animal has attained its full size. The surface of the posterior end of the tube, also, is marked by rather faint, but broad, swellings, which alternate with obscure, narrow constrictions at irregular intervals, and its closed termination anteriorly is subtruncated, with the edges slightly bevelled off.

South-west side of Denman Island, in Division B; J. Richardson, 1872. Sucia Islands, in Division A; J. Richardson, 1874. Tubes also, which may belong to this species, were found at the east end of Denman Island, in Division C, but no shells have been found in them, and the specimens may have been derived from the underlying shales of Division B.

An interesting and very curious species, of which only seven detached valves have been obtained, none of which are quite perfect. In some respects *T. Suciensis* comes very near to *T. partita*, *T. crassula* and *T. torulosa* of Stoliczka,* from the Cretaceous rocks of Southern India, but at present it cannot be satisfactorily identified with either. The delicate surface markings of the valves of *T. partita* and *T. torulosa* appear to differ from those of *T. Suciensis* in more than one particular. Thus the central area of *T. partita* is separated from the posterior side by a single deep groove, and the striations of its whole surface are described as being "extremely fine, so much so that they are often barely traceable." As already pointed out, there are two faint, shallow grooves with an obscure ridge between them on the anterior boundary of the posterior area in *T. Suciensis*, and in that species the striations or fine ribs on the same area are very strongly marked. In *T. torulosa* there is stated to be a single wide groove between the central and posterior areas, and its central area is described as being wide, whereas it is very narrow in *T. Suciensis*. So far as the sculpture alone is concerned, there are several

* Cretaceous Pelecypoda of Southern India, pp. 15 and 16, pl. 1, figs 1, 2, and 3.

points in which *T. crassula* resembles the present species. The most noticeable of these are, first, that both have two furrows or grooves, which, to use Stoliczka's words, "run along the greatest convexity from near the apex to the periphery," and, secondly, that the anterior auricle of both is minutely striated. But, on the other hand, the striæ on the posterior auricle of *T. crassula* are stated to be finer than those on the median area, the opposite being the case in *T. Suciensis*, and further, if Stoliczka's figure be correct, which there is no reason to doubt, the height of the valves of *T. crassula* is greater than their length, whereas in *T. Suciensis* the shell is certainly longer than high.

Martesia clausa, Gabb.

Plate 17, figures 2, 2*a* and 2*b*.

Martesia clausa, Gabb.—Pal. Cal., Vol. I., p. 145, pl. 22, fig. 115.

Productive Coal Measures, Division A, of North West Bay, V. I.: J. Richardson, 1871. Several very perfect specimens boring into fossil wood.

The Vancouver Island variety of *Martesia clausa* is more elongated than the type of the species figured in the "Palæontology of California," and its double umbonal groove is much narrower. The umbonal groove of the Californian shell is said to widen rather rapidly below, but in Mr Richardson's specimens there is an exceedingly narrow, linear, flattened ridge, scarcely any wider at the ventral margin than near the beaks, with a shallow groove on each side of it. The calcareous filling up of the anterior gap, or foot opening, appears to be divided in a line with the opening of the valves; it is much swollen and projects somewhat beyond the front margin of the valves. The umbonal accessory valve or plate is preserved in two of the specimens from North West Bay: its outline is broadly oval, the width being greater than the length, and in front, between the beaks, it is developed into a small rounded lobe. Along its centre there is a longitudinal line, which divides the plate into two nearly equal portions, but the dividing line is a little sinuous posteriorly, and may possibly have been caused by an accidental fracture. It cannot at present be positively stated that the umbonal valve or plate is divided longitudinally in its normal state, but if such should prove to be the case the species would agree better with the definition of *Parapholas* that with that of *Martesia*. Stoliczka, however, says that the distinction between these genera, which is based principally on the division or non-division of the umbonal plate, "scarcely deserves

to be regarded as of generic value,* as has already been stated on page fifty-five of the present volume.

Corbula Traskii? Gabb.

Plate 17, figure 3.

Corbula Traskii, Gabb.—Pal. Cal., Vol. I., p. 149, pl. 22, figs. 121 and 121*a*.

Middle Shales, Division D, of the north-west side of Hornby Island; J. Richardson, 1872. Three imperfectly preserved right valves.

The specimens are in such poor condition that their determination is far from certain, still they are so much like Mr. Gabb's figures of *C. Traskii* that their identity with that species is highly probable. The test of these three *Corbulæ* from Hornby Island is more or less coarsely and irregularly striated, rather than costate, but the sculpture of some Cretaceous species of *Corbulæ* is known to be variable. Thus the valves of *C. pyriformis*, Meek, good examples of which were collected by Mr. Selwyn in 1875, at Pine River Forks, and on the Upper Peace River, in British Columbia, are indifferently either finely striated or coarsely ribbed.

Corbula minima, D'Orbigny.

Plate 17, figures 4 and 4*a*.

Corbula minima, D'Orb. Stoliczka—Cret. Pelecyp. S. India, p. 44, pl. 1, figs. 19-22, and pl. 16, figs. 7–12.

Same locality, division and collector as the last; one right and one left valve, both nearly perfect and well preserved.

The Californian analogue of this species is *C. Hornii* of Gabb, which is possibly the same shell as the *C. truncata* of D'Orbigny, but not of Sowerby. *C. minima* has a flatter shell than *C. Hornii*; the posterior end of the former is not so much elongated as it is in the latter species, and in *C. minima* there is an acute umbonal ridge on the posterior end of both valves, which is wanting on the right valve of *C. Hornii*.

Periploma suborbiculatum. (N. Sp.)

Plate 17, figure 6.

Shell inequivalve and inequilateral, compressed at the sides, but somewhat tumid in the umbonal region; test very thin, posterior margin of the valves curved a little to the left; length slightly greater than the height. Outline subcircular, the lower half of the margin of the valves, in particular, being regularly rounded; superior border sloping convexly

* Cretaceous Pelecypoda of Southern India, p. 24.

and very gently downwards in front, descending abruptly and somewhat obliquely, but not convexly, behind: posterior side very short and contracted; beaks small, curved backwards, not much elevated, placed distinctly behind the middle; umbo apparently fissured, the fissure narrow, slightly curved, and extending from the beaks about half-way across the valves. Behind the umbonal fissure, and in the centre of the space between it and the posterior margin, there appears to be a second, but much shorter, impressed line.

Surface marked by irregularly disposed, concentric striæ of growth.

Length, nine lines; height, eight lines and a quarter.

Nanaimo River, V. I., two miles and a quarter up, in Division A; J. Richardson, 1872. A single perfect specimen, with both valves in apposition. The left valve is partly buried in the rock, but it appears to be the most convex of the two. The impressed line on the umbones may indicate an acute, raised lamina on the inner surface of the valves, rather than an umbonal fissure.

Anatina sulcatina, Shumard.

Plate 17, figures 5 and 5*a*.

Anatina sulcatina, B. F. Shumard.—Proc. Boston Nat. Hist. Soc., 1861, Vol. 8, p. 204.

Sucia Islands, in Division A; J. Richardson, 1875. Three fine specimens.

The following is Dr. Shumard's description of *Anatina sulcatina*:—

"Shell large, ovate, thin, inequivalve, very inequilateral: *length not quite equal to the width;* anterior end broadly rounded; posterior end short, contracted, narrowly rounded; pallial margin gently convex; beaks small, but little elevated, situated posterior to the middle; cardinal margin straight, or very slightly convex before the beaks, and very slightly arched behind; a narrow, distinctly impressed, and very gradually expanding sulcus, extending from beak to pallial margin, which it cuts a little behind the middle; surface with from twenty to twenty-five rounded, concentric folds, becoming indistinct on the posterior part of the shell. There are also many fine, concentric lines of growth visible to the naked eye."

"Length, 3½ inches; width, 1½ inches; thickness, 6½ lines."

"Ripley Group, Chatfield Point, Navarro County," Texas.

The measurements show that the length is rather more than twice the width or height, and the words italicized in the above diagnosis are, therefore, obviously incorrect. The transverse groove or sulcus, which

Dr. Shumard says is "distinctly impressed" in the types from Texas, is broad, shallow and obscure in the Sucia Island specimens, but these latter are all more or less distorted by lateral compression.

ANATINA TRYONIANA, GABB.

Anatina Tryoniana, Gabb.—Pal. Cal, Vol. I., p. 150, pl. 29, fig. 240.

Lower Shales, Division B, at Gabriola Island; J. Richardson, 1872. One specimen with both valves preserved, but with a small portion of the posterior end broken off.

(ANATINA QUADRATA, GABB.

Anatina quadrata, Gabb.—Pal. Cal., Vol. II., p. 177, pl. 29, fig. 64.

"From the greenish rock on the north shore of Departure Bay, Nanaimo, Vancouver Island; associated with *Pecten Traskii*, *Trigonia Evansana* and other species characteristic of the Chico Group of California." Gabb. Possibly an elongated form of *Thracia subtruncata*, Meek, but if not it has not been detected in any of Mr. Richardson's collections.)

THRACIA SUBTRUNCATA, MEEK.

Plate 17, figure 7.

Thracia? subtruncata, Meek.—Trans. Alb. Inst., 1857, Vol. IV., p. 44.

" " " Bul. Geol. & Geogr. Surv. of Terr., Vol. II., No. 4, p. 363, pl. 2, figs. 4 and 4*a*.

Nanaimo, V. I. Meek. Sucia Islands, in Division A; J. Richardson, 1874. One tolerably good specimen.

PHOLADOMYA ROYANA, D'ORBIGNY.

Pholadomya Royana, D'Orbigny, —Pal. Franc., Terr. Cret., Vol. III., p. 360, pl. 367.

Pholadomya subelongata, Meek. —Trans. Alb. Inst., 1857, Vol. IV., p. 41.

" " —Bul. Geol. & Geogr. Surv. of Terr., Vol. II., No. 4, p. 362, pl. 2, figs. 1 and 1*a*.

Pholadomya Brewerii, Gabb. —Pal. Cal., Vol. I., p. 152, pl. 22, fig. 123.

Nanaimo, V. I., and Newcastle Island. Meek. (*P. subelongata.*) Gabriola Island, in Division B (two specimens); Sucia Islands, in Division A (one specimen); J. Richardson, 1872 and 1874.

A critical comparison of the description and figures of *P. Royana* with those of *P. subelongata* has led to the conclusion that the two shells are identical. Both have the same transversely elongated, slightly curved elliptical outline: the beaks of each are subterminal, and the radiating ribs of both are acute, and become nearly obsolete at the posterior and

anterior end. The number of ribs, also, is variable in both; Meek says there are from sixteen to twenty-five in *P. subelongata*, and D'Orbigny figures two extreme forms of *P. Royana*, one of which has ten ribs and a half, and the other twenty-nine. The Gabriola Island specimens of *P. Royana* have the beaks placed at a considerable distance from the anterior end, and the length of their shells is not, proportionately, so great as is that of the type of *P. subelongata*. In the latter respect they approach very near to *P. Brewerii*, Gabb, which appears to be only a short variety of *P. Royana*.

HOMOMYA CONCENTRICA, GABB.

Panopæa concentrica, Gabb.—Pal. Cal, Vol. I., p. 148, pl. 22, fig. 119.
Homomya concentrica, Gabb.—Id., Vol. II., p.p. 179 and 236.

Sucia Islands, in Division A; J. Richardson, 1874. Two specimens: the largest and most perfect four inches and a-half in length, three inches in height, and two inches and two lines in thickness through the closed valves. The test is marked by coarse, irregular, concentric plications and more or less fine striæ of growth, but it can scarcely be said to be ribbed.

(GONIOMYA BOREALIS, MEEK.

Pholadomya (*Goniomya*) *borealis*, Meek.—Trans. Alb. Inst., Vol. IV., (1857) p. 41.
Goniomya borealis, Meek. —Bul. Geol. & Geogr. Surv. of Terr., Vol. II., No. 4, p. 362, pl. 2, fig. 2.

Nanaimo, Vancouver Island. Meek. Not in any of Mr. Richardson's collections.)

CYMBOPHORA ASHBURNERII, GABB.

Plate 17, figure 8.

Mactra Ashburnerii, Gabb .—Pal. Cal., Vol. I., p. 153, pl. 22, fig. 127. Ribbed variety only.
Cymbophora Ashburnerii, Gabb.—Id., Vol. II., p. 181, pl. 29. fig. 69.

Middle Shales, Division D, of the north-west side of Hornby Island; Lower Shales, Division B, at Gabriola Island; Blunden Point, V. I., Protection and Sucia Islands, in Division A. J. Richardson, 1871-75.

The hinge teeth are not exposed in any of the specimens from the above mentioned localities, but the sculpture of the exterior of the shell is very different to that of any other species of *Mactra* from the Cretaceous rocks of North America, and accords perfectly with Mr. Gabb's description of the ribbed variety of *C. Ashburnerii*. The central area of the valves is ornamented with large, prominent, rounded and rather regular,

concentric ribs, which are usually much wider than the deep, narrow grooves between them. On the lunule and escutcheon the ribs are small, narrow and acute, and commence at the superior border both in front and behind as simple raised lines.

The specific characters of this shell are very nearly the same as those of a *Mactra* from the Cretaceous rocks of Southern India, described by Professor Forbes under the name *Mactra tripartita*, G. B. Sowerby, MSS.* Stoliczka says that the central area of *M. tripartita* is divided from the lunule by a narrow groove, and from the escutcheon by a broad, shallow sulcus, neither of which are to be seen in any of the specimens collected by Mr. Richardson, but these markings are not mentioned in Forbes' description of *M. tripartita*, nor are they indicated in either of Stoliczka's figures of that shell.

Mactra (Cymbophora ?) Warrenana, Meek & Hayden.

Plate 17, figure 9, and plate 19, figures 3 and 3*a*.

Mactra Warrenana, Meek & Hayden. —Proc. Ac. Nat. Sc., Phil., Vol. VIII. (1856), p. 271.

Mactra (Cymbophora) Warrenana, Meek.—Rep. Inv. Cret and Tert. Foss. U. Miss. Co., p. 208, pl. 30, figs. 7, *a*, *b*, *c*, *d*.

Collected by Mr. Richardson at the same localities and from the same divisions as the preceding species, also at Newcastle Island, and two miles and a half up the Nanaimo River, V. I., in Division A.

The specimens have been compared with authentic examples of *M. Warrenana* from Dakota, received from Mr. Meek, and no appreciable differences could be perceived between them.

The present shell may be the same as the smooth form of *C. Ashburnerii*, but Mr. Gabb's description of the latter embraces such a wide range of variation that there are few species of *Mactra* from the Cretaceous rocks of North America to which it would not apply. Conrad claims† that two species have been confounded together under the name *C. Ashburnerii*, one of which is strongly ribbed, and the other marked only by fine lines of growth, but he is certainly mistaken in the supposition that the latter is an Eocene fossil. In the Vancouver Cretaceous these smooth Mactras may be distinguished at a glance from the large and coarsely ribbed variety of *C. Ashburnerii*, with which they are almost invariably found associated, by their smaller size, more decidedly triangular outline, and, more especially,

* Transactions of the Geological Society of London, Series II., Vol. VII., p. 142, pl. 15, fig. 17.
† American Journal of Conchology, Vol. I., p. 364.

by their peculiar and apparently constant sculpture, which is not very well represented in the figure on plate seventeen.* The surface is marked by from one to three faint, shallow grooves, or arrests of growth, which extend from margin to margin. When there are three of these grooves, which there generally are in adult shells, the first and second are wide apart, and the second and third comparatively close together. In addition to these markings, the central area of the valves, though polished and apparently smooth, or nearly so, to the naked eye, when examined with a lens is seen to be covered with regularly arranged, crowded and minute concentric striæ. On the lunule and escutcheon these striæ are developed into prominent, rather distant, rib-like ridges, which are plainly visible without the aid of a magnifying glass. So far as the surface markings are concerned no intermediate gradations have as yet been observed between these finely striated and coarsely ribbed shells.

M. Warrenana appears to be closely allied to the *M. angulata* of Sowerby,† but the description of the latter shell is too short and insufficient to allow of an accurate comparison between the two species.

Tellina (Peronæoderma?) Mathewsoni, Gabb.

Tellina Mathewsoni, Gabb.—Pal. Cal., Vol. I., p. 158, pl. 23, fig. 136.

Nanaimo River, V. I., two miles and a half up, in Division A; J. Richardson, 1875. A somewhat imperfect cast with portions of the test preserved. Mr. Gabb says that the beaks of this species are central, but in his figure of the shell they are represented as slightly behind the middle. In the specimen from Vancouver Island their position is distinctly behind the middle.

Tellina (Œne?) Sp. Undt.

Plate 17, figure 10.

Shell small, much compressed, transversely and narrowly sub-elliptical, about twice as long as high, test extremely thin. Extremities narrowly rounded, the posterior being rather narrower than the anterior; anterior side produced, elongated; posterior side short. A small posterior area is very obscurely indicated by an abrupt and obliquely convex compression of the valves behind and above a line which might be drawn from the rear of the beaks to the base, but the umbonal ridge is not very

* As this figure has not proved satisfactory, two additional illustrations of the species have been given on plate 19.

† Transactions of the Geological Society of London, Series II., Vol. IV., (1836) p. 341, pl. 16, fig. 9.

distinct or well defined in the upper half of the shell, and disappears entirely in the lower. Beaks very small, not much elevated, pointing backwards and placed a little behind the middle. Dorsal margin sloping in both directions from the beaks; the posterior slope descending obliquely and rather rapidly; the anterior straighter and more nearly horizontal. Ventral border nearly straight for the greater part of the length, but rounding upwards at the anterior end. Hinge teeth and muscular impressions unknown.

Surface marked by exceedingly fine and delicate concentric striæ, or crowded lines of growth.

Length, about three lines and a half; height, not quite two lines.

Vesuvius Bay, Salt Spring or Admiralty Island, in Division A; J. Richardson, 1875. A detached left valve.

This fragile and glassy little shell appears to be undescribed, but as the only specimen collected is an imperfect valve, probably of an immature individual, it is not thought desirable to give it a new specific name. It is rather closely allied to *T. (Œne) subscitula*, Meek,* but is more narrowly elongated, has smaller and less elevated beaks, a much straighter ventral margin, and no trace of any flexure on the posterior side. In the general outline of its valves it seems to approach rather nearly to *Œnona papyria* of Conrad,† but the latter shell is described as "convex," and its ventral margin is said to be "regularly curved." Moreover, one of the characters of the subgenus *Œnona* is its very narrow, lanceolate lunule, marked by a deeply impressed line, while no indications of any definitely margined lunule can be detected in the present species.

Tellina (Palæomœra ?) quadrata, Gabb.

Tellina quadrata, Gabb.—Pal. Cal., Vol. I., p. 159, pl. 23, fig. 138.

Middle Shales, Division D, north-west side of Hornby Island; J. Richardson, 1872. A well preserved and nearly perfect left valve.

Tellina (Peronæa) occidentalis, Meek. (Sp.)

Plate 17, figures 11 and 11*a*.

Thracia (?) occidentalis, Meek.—Trans. Alb. Inst., 1857, Vol. IV., p. 44.
—Bul, Geol. & Geogr. Surv. of Terr., Vol. II., No. 4, p. 363, pl. 2, figs. 3 and 3*a*.

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* See Meek's Report on the Cretaceous and Tertiary Fossils of the Upper Missouri Country, p. 195, pl. 2, figs. 11, *a*, *b*.
† American Journal of Conchology, Volume VI. (1870-71), p. 74.

Not *Tellina occidentalis*, Morton. —Jour. Ac. Nat. Sc. Phil., 1842, Vol. VIII., p. 210, pl. 11, fig. 3, which, according to Owen & Meek, is a *Lucina*.

?= *Tellina equilateralis*, Meek & Hayden.—1856. See Meek's Rep. on the Inv. Cret. and Tert. Foss. of the U. Miss. Co., p. 196, pl. 39, figs. 5*a*, *b*, *c*.

Compare also *Tellina Royana*, D'Orb. —Pal. Franc., Terr. Cret., Vol. III., p. 422 pl. 380, figs. 9-11.

Shell inequilateral, transversely subelliptical, about one-third longer than high, moderately convex, but a little compressed at the sides, test rather thin. Extremities narrowly rounded, the anterior side being the shortest and narrowest of the two; outline of base forming a broad, semi-elliptical curve. Dorsal margin sloping obliquely and somewhat rapidly in front of the beaks, and less so behind them; beaks small, not prominent or elevated, directed forwards and placed a little in advance of the middle. Postero-dorsal region compressed behind the posterior umbonal slopes.

Surface marked by irregular, concentric striations. Hinge teeth unknown. Pallial sinus elongated, oblique, ascending, with parallel or nearly parallel sides, and narrowly rounded at its inner termination below, but immediately under the beaks.

Length, fifteen lines and a half; height, ten lines.

Nanaimo, V. I., Meek (*Thracia occidentalis*). Lower Shales, Division B, at Gabriola Island (one example with both valves and most of the test preserved); also two miles and a half up the Nanaimo River, V. I., in Division A (four casts with portions of the shell remaining); J. Richardson, 1872.

The pallial line and muscular impressions are well defined in most of Mr. Richardson's specimens, and the shape of the sinus and direction of the beaks both show that the true position of this shell is in one of the subordinate groups into which the Linnæan genus *Tellina* has been divided, most likely, judging by its external characters only, in Poli's subgenus *Peronæa* as defined by recent systematists. As far as can be ascertained at present, the line of opening of the valves below is straight, and not curved posteriorly, and this appears to be the only difference between it and *Tellina equilateralis* of Meek & Hayden, the anal end of which is said to be "slightly flexed to the left." *T. occidentalis* of Meek, not Morton, is probably only a variety of *T. Royana*, D'Orbigny, in which the beaks are placed a little nearer than usual to the anterior end.

Linearia Suciensis. (N. Sp.)

Plate 17, figure 12.

Compare *Tellina strigata*, Goldfuss.—Petrefacta Germaniæ, Vol. II., p. 235, pl. 147, figs. 18*a*, *b*.

Shell compressed-convex, nearly equilateral, transversely subelliptical, length about one-third greater than the height, test rather thin. Anterior side narrowly rounded, posterior side a little longer than the anterior, subtruncated nearly vertically at the end, but most prominent above, and subangular at its junction with the ventral margin below; posterior area flattened obliquely, but without any distinct umbonal ridge; base nearly straight in the middle, but rounding upwards at each extremity. Beaks small, rather broad, but not prominent nor elevated, placed a little in advance of the middle and pointing distinctly forwards. Dorsal margin sloping very gently and somewhat convexly downwards in both directions, but slightly concave immediately under the beaks in front.

Surface marked by extremely fine, crowded, concentric striæ, and by radiating impressed lines. The latter are most strongly marked on the upper half of the shell, and become nearly obsolete before reaching the ventral margin. On the upper slopes of both extremities, especially on the posterior area, the radiating impressed lines are comparatively broad, so much so as to give to these declivities a finely ribbed aspect to the naked eye, but on the central area of the valves the impressed lines are very narrow and not visible without the use of a lens.

Hinge teeth and muscular impressions unknown.

Length, about eleven lines and a quarter; height, seven lines.

Sucia Islands, in Division A; J. Richardson, 1875. One right valve.

A very interesting little shell, whose external characters seem to be intermediate between those of *Palæomæra*, Stoliczka, and *Linearia*, Conrad. Its shape and surface ornamentation, both of which are very peculiar, are so like those of *Tellina strigata*, Goldfuss (the type of *Palæomæra*), that it may be only a variety of that species. The most appreciable difference between the two shells is that the beaks of *L. Suciensis* are placed very slightly in front of the middle, whereas those of *T. strigata* are situated a little behind the centre.

Tellina (*Linearia*) *sculptilis* of Stoliczka, from the Cretaceous rocks of Southern India, is also very nearly allied to the present species, and may perhaps be identical with it, but the beaks of the Indian shell are

described as prominent, and as being placed behind the middle, so that its posterior side is the shortest of the two. It is not easy to see why *T. strigata*, Goldfuss, and *T. sculptilis*, Stoliczka, are placed in different subgenera.

Linearia (Leiothyris) Meekana, Whiteaves.

Tellina Meekiana, Whiteaves.—Geol. Surv. of Canada, Rep. of Progress 1873-74, p. 268, pl. of foss., fig. 6.

Shell compressed, very slightly convex, transversely but broadly ovate, the height (in the most perfect specimen known) being rather more than three-fourths of the length; test thin. Anterior side short and broadly rounded; posterior side much longer and narrower, bluntly pointed or very narrowly subtruncated at the end; outline of the basal half of the shell forming a regular semi-ovate curve. Beaks small, depressed, pointing forwards and placed about half way between the centre and the anterior end. Dorsal margin sloping convexly and very gradually downwards behind the beaks, straighter and descending much more rapidly and abruptly in front of them. Escutcheon or ligamental area very narrow, obliquely and slightly compressed, not bounded in each valve by a distinct umbonal ridge.

Surface marked by crowded, but rather irregular and not very minute, concentric striations. Hinge teeth unknown. Pallial sinus oblique, ascending, rather deep, extending nearly or quite to the middle of the valves and narrowly rounded at its inner termination.

Length, sixteen lines; height, thirteen.

Gabriola Island, in Division B; J. Richardson, 1871. The least perfect of the only two specimens yet obtained is narrower in proportion to its height than the one from which the above description was made.

The only fossil from the Cretaceous rocks of North America that might be mistaken for this species is the "*Tellina* (*Arcopagia?*) *Cheyennensis*" of Meek & Hayden,* from the forks of the Cheyenne River, Dakotah, but the last named shell may be readily distinguished by its more prominent beaks and by its larger and wider escutcheon.

* See Meek's Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country, p. 607, pl. 17, fig .16.

Cytherea (Callista) laciniata, Stoliczka.

Plate 17, figures 13 and 13*a*, and plate 19, figures 4 and 4*a*.

Cytherea (Callista) laciniata, Stoliczka. —Cret. Pelecyp. S. India, p. 174, pl. 7, figs. 5-6.

Compare *Cytherea (Callista) sculpturata*, Stol.—Id. p. 173, pl. 7, figs. 7-9.

Shell convex, inequilateral, very variable in shape; outline transversely and broadly ovate, ovately subtrigonal or subquadrangular but always a little longer than high. Beaks moderately large, slightly elevated in some specimens, but a little depressed in others, approximate, acute, curved inwards and forwards, and placed about half-way between the centre and the anterior margin. Superior border sloping concavely downwards in front and convexly behind; ventral margin forming a broad, semi-ovate curve, or gibbous near the anterior end and straighter or curving more gradually upwards near the posterior. Hinge area small, lanceolate, concavely and rather deeply excavated. Lunule small, narrow, ovate-cordate, and margined by a faintly impressed line.

Surface polished and concentrically ribbed; the ribs rounded, and wider than the deep furrows between them; not obsolete or nearly so on the umbones.

Pallial sinus deep, subangular, bluntly pointed, and extending to the middle of the shell. Left valve with three divergent teeth besides the sublunular tooth. The two cardinal teeth are short, and nearly transverse to the hinge line; the lateral tooth is elongated, nearly horizontal, and parallel with the fulcrum, from which it is separated by a narrow and not very deep groove. Right valve without any distinct sublunular tooth.

N. W. side of Hornby Island, in Division D, a fragment of a left valve; Sucia Islands, in Division A, abundant; J. Richardson, 1871, 1874 and 1875.

A small, neat and concentrically ribbed species, whose characters appear to be almost exactly the same as those of *C. laciniata*, described by Stoliczka, though the umbones of the latter shell are said to be nearly smooth, and its lunule is not described as margined by an impressed line. It may be that *C. laciniata* is only the young shell of *C. sculpturata*, Stoliczka. The Sucia Island specimens of the present species have the same shape and apparently the same kind of lunule as the *Meretrix arata* of Gabb, from the Chico group of California, but the surface of *M. arata* is said to be "ornamented by regular, concentric, acute impressed lines."

Cytherea (Caryatis) plana, Sowerby.

Plate 17, figures 14, 14*a*, and 14*b*.

Venus planus, Sowerby.	—Min. Conch., Vol. I., (1812) p. 58, pl. 20, lower figures.
Cytherea plana, Goldfuss.	—Petr. Germaniæ, Vol. II., p. 138, pl. 148, fig. 4.
Venus plana (Sowerby), D'Orbigny.	—Pal. Tranc., Terr. Cret., Vol. III., p. 447, Atlas, pl. 386, figs. 1-3.
Cytherea plana, Sowerby, Sp. Stoliczka.	—Cret. Pelecyp. S. India, p. 169, pl. 7, figs. 1-4
?=Cytherea Leonensis, Conrad.	—Emory's Rep. on the U.S. & Mex. Bound. Surv., 1857, Vol. I., p. 153, pl. 6, fig. 1.
?=Meretrix Tippana, Conrad.	—Jour. Ac. Nat. Sc. Phil., 1858, Series II., Vol. III., p. 326, pl. 34, fig. 18.
Aphrodina Tippana, Con.	—Am. Jour. Conch., 1868, Vol. IV., p. 246, pl. 18, fig. 5.
Compare also *Meretrix nitida*, Gabb.	—Pal. Cal., Vol. I., p. 165, pl. 23, figs. 145 and 146.
Caryatis nitida, Gabb.	—Id., Vol. II., p.p. 186 and 240, pl. 30, fig. 79.

Shell moderately convex, very inequilateral, variable in outline, but usually ovately subtriangular, length always a little greater than the height; test rather thick. Umbones broad and tumid in full grown shells, less so in small specimens; beaks very small, usually depressed but rarely a little elevated, curved inwards, downwards and somewhat forwards, placed at a distance from the anterior end of about one-third the entire length, or less, but never quite terminal. Anterior dorsal slope short, abrupt, and slightly excavated; posterior dorsal declivity longer, convex, and more gradual in its descent; outline of the basal margin forming a broad, semi-ovate curve, most prominent a little in advance of the middle; anterior end narrowly rounded; posterior end subtruncated. Lunule elongated, lanceolate or lanceolate cordate; bordered by an impressed line.

Surface polished, nearly smooth, marked by concentric striations, most of which are plainly visible to the naked eye, and on the upper and central parts only of the posterior end by very minute radiating lines which cannot be seen without the help of a lens. Pallial sinus deep, angular, pointed, and extending inwards nearly to the centre of the shell.

Right valve with three hinge teeth and a sublunular tooth. The two cardinal teeth are small, short, close together, and slightly divergent; they are placed immediately under the beaks, and are nearly transverse to the hinge line. The lateral tooth is elongated, oblique, and nearly

parallel with the hinge line behind; its summit, too, is concavely and sinuously grooved. The sublunular tooth, which is also elongated, commences at the margin of the valve opposite the base of the lunule; it ascends nearly parallel with the said margin, but separated from it by a deep groove, and terminates at a point opposite to the centre of the lunule.

The left valve has three hinge teeth, but no sublunular tooth. The two cardinal teeth diverge rather widely from above downwards, and the lateral tooth is parallel with the hinge line behind, from which it is separated only by a narrow and not very deep groove. The teeth of the left valve are not so well preserved as those of the right, and it is not yet known whether the anterior tooth in the left valve of the specimens collected by Mr. Richardson is larger than the middle one or not, though it certainly is as large, or whether the lateral tooth of the same valve is transversely rugose or smooth.

Middle Shales, Division D, north-west side of Hornby Island, four small single valves. Productive Coal Measures, Division A, at the entrance to Departure Bay, V. I., (one imperfect valve) and on the Nanaimo River, two miles and a quarter up (two examples), also at the Sucia Islands, where it is rather frequent; J. Richardson, 1871-75.

Although specimens from the above mentioned localities are variable in shape, as already mentioned, yet they do not appear to be nearly as much so as the Indian examples of *C. plana* figured by Stoliczka It would seem that the larger the shells the longer they are in proportion to their height, and *vice versa*. In some of Mr. Richardson's specimens the posterior end is so short and so broadly truncated as to give a subquadrate outline to the shell, but in others the anal side is produced and narrowly subtruncated or bluntly pointed at its termination. Again, out of twelve examples of *C. plana* from the Sucia Islands the apices of the beaks in eight are sunk decidedly below the highest level of the hinge line, and this appears to be always the case in adult shells, but in the four remaining, the largest of which is scarcely an inch long, the beaks are very slightly elevated.

Sowerby's description of *Venus plana* is too short to be very satisfactory, but his figures of the shell are excellent. Mr. Richardson's specimens are extremely like the types of the species, much more so than are the four Indian examples of *C. plana* represented by Stoliczka, and the characters of the former have been described rather minutely, to facilitate a comparison between them and two or three nominal species of *Veneridæ*

from the Cretaceous rocks of North America, which are probably nothing more than varieties of this well known European shell.

The first of these is the *Cytherea Leonensis* of Conrad, which Mr. Etheridge says is the commonest fossil at Nanaimo * Conrad's figure of *C. Leonensis* suggests the idea that the original may be an elongated variety of *Cytherea plana* with a rather strongly excavated lunular declivity, and an exceptionally long and narrow, but imperfect right valve of *C. plana* found by Mr. Richardson at Nanaimo rather favours this hypothesis.

Meretrix Tippana, Conrad, of which only a single left valve is known, and which is the type of Conrad's subgenus *Aphrodina*, is still more like the present species, not only in the general outline of the shell, but also in the shape of the pallial sinus and in the dentition of the hinge, as may be seen by any one who will take the trouble to compare Conrad's figure of the interior of *A. Tippana* in the fourth volume of the "American Journal of Conchology" with the corresponding figures of the same valve of *C. plana* in the first volume of the "Mineral Conchology," or in the third of the "Paleontologia Indica."

Caryatis nitida, Gabb, from the Chico Group of California, is probably also a local variety of *C. plana*. Mr. Gabb does not give a figure of an adult specimen of *C. nitida*, but his drawing of the young shell† corresponds to a not unusual form of *C. plana* when half grown, in which the beaks are elevated and the outline of the margin of the valves is somewhat rounded.

(Cytherea Leonensis, Conrad.

Nanaimo, V. I. Etheridge. See the remarks which follow after the description of the preceding species.)

Dosinia gyrata, Gabb.

Dosinia gyrata, Gabb.—Pal. Cal., Vol. I., p. 168, pl. 23, fig. 148.

Sucia Islands, in Division A; J. Richardson, 1875. A single right valve.

Eriphyla umbonata, Gabb.

Eriphyla umbonata, Gabb.—Pal. Cal., Vol I., p. 180, pl. 24, figs. 162 and 162*a*.

Nanaimo River, V. I., two miles and a quarter up and at the Sucia Islands, in Division A; J. Richardson, 1872 and 1874. Five good speci-

* Quarterly Journal of the Geological Society of London, 1861, Vol. XVII., p. 432.

† In the second volume of the Palæontology of California, pl. 30, fig. 7, which should be compared with the specimen represented by Stoliczka in Vol. III. of the Indian Palæontology, pl. 7, fig. 3.

mens. The hinge teeth show that the species is a true *Eriphyla*, but the beaks are not quite as prominent in the shells from the Vancouver Cretaceous as they are in the types from California.

Cyprimeria lens, Gabb. (Sp.)

Plate 17, figures 15 and 15*a*.

Mœrstrix lens, Gabb.—Pal. Cal., Vol. I., p. 164, pl. 23, fig. 143.

North-west side of Hornby Island, in Division D; and Sucia Islands, in Division A. The few specimens collected by Mr. Richardson all belong to the broadly and transversely ovate, or subcircular form of the species. There is no distinctly margined or well defined lunule, and the three hinge teeth of the left valve are well shown. The first and second are slightly divergent, and the third, or posterior tooth, is parallel to the thick fulcrum, from which it is only separated in part by a shallow groove. The second and third teeth are thin and laminar, but the first, or anterior tooth, is thick, and excavated in the middle, but not bifid. It would appear also that there is a distinct sublunular tooth in the right valve.

(Cyprimeria ? tenuis, Meek.

Dosinia ? tenuis, Meek. —Proc. Ac. Nat. Sc. Phil., 1861., Vol. XIII., p. 315.
Cyprimeria ? tenuis, Meek.—Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4, p. 361, pl. 2, figs. 5, 5*a* and 5*b*.

"At several places near Nanaimo, Vancouver Island, and on Newcastle Island; Cretaceous." Meek. Not in any of Mr. Richardson's collections.)

Genus Thetiopsis, Meek.

See Meek's "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," page 191.

Shell like that of *Thetis* (Sowerby), but with the pallial sinus comparatively short and not ascending higher than the centre of the shell. Pallial line crenated on either side of the sinus. Hinge teeth unknown. Type: *Venus (?) Circularis*, Meek & Hayden.

Thetiopsis circularis, Meek & Hayden. (Sp.)

Venus (?) circularis, Meek & Hayden.—Proc. Ac. Nat. Sc. Phil., 1856, Vol. VIII., p. 272.
Cyclina (?) circularis, Meek. —Smithsonian Check-list N. Am. Cret. Fossils, 1864, p. 13.
Lucina Richardsonii, Whiteaves. —Geol. Surv. of Can., Rep. of Progr. for 1873-74, p. 266, plate of fossils, fig. 1.
Thetis (?) circularis, Meek. —Rep. on Inv. Cret. and Tert. Foss. of the U. Miss. Co., 1876, p. 190, pl. 17, figs. 8, *a*, *b*, *c*.

Hornby Island, north-west side, in Division D (one). Nanaimo River, V. I., ten miles up (one), and at the Sucia Islands (two), in Division A; J. Richardson, 1871-75.

The type of *Lucina Richardsonii*, from ten miles up the Nanaimo River, is a nearly perfect specimen with the valves closed, and consequently with all the characters of the interior hidden from view. In proposing a provisional name for this shell the writer was much influenced by the statement previously made by Mr. Billings, on the authority of Messrs. Meek, Hayden & Gabb, that "the fossils of the Cretaceous formation on the east side of the Rocky Mountains are nearly all specifically distinct from those that occur in rocks of the same age on the west side,"* though the facts of the case, as we now know them, are far from corroborating this statement. One of the Sucia Island specimens of this species shows the pallial sinus very well, also the curiously crenated margin of the pallial line on either side of it, and all four accord exactly with Meek's figures and description of *Thetis circularis*, though Meek says that the beaks of *T. circularis* are curved obliquely forward and inward, whereas the beaks of Mr. Richardson's shells are divergent and curve outwards at their apices, much as in most species of *Dosinia*.

Veniella crassa. (N. Sp.)

Plate 18, figure 1.

Shell tumid, gibbous, but not as thick as high, very inequilateral; outline transversely ovate or ovately subtrigonal; length nearly a third greater than the height; test thick, except round the ventral margin, where it suddenly becomes thin and sharp. Anterior side very short, its margin slightly concave from the beaks to the middle, below which it rounds rapidly and abruptly into the curve of the ventral border; posterior side elongated, somewhat wedge shaped, but apparently obliquely

* Geological Survey of Canada. Report of Progress for 1872-73, p. 71.

truncated at its extremity; base semi-ovate. Beaks small, approximate, depressed, curved inwards and a little forwards, anterior, but not quite terminal. Behind the beaks the superior margin ascends, first in a broad and very slightly convex curve, after which it slopes gradually and gently downwards to the upper margin of the posterior end. Lunule not very distinctly defined, shortly and broadly lanceolate in outline, rather deeply excavated. In the rear of the beaks there are two areas, one of which is inside the other. The inner area, which appears to extend from the beaks to the posterior termination of the hinge line, is narrowly lanceolate, as seen from above, deeply excavated, and bounded on both sides by a sharp keel. The outer area is indicated only by an oblique flattening of the valves above, in the direction of a line which might be drawn from the beaks to the lower extremity of the posterior end, and its outline is broadly lanceolate. The hinge teeth are unknown, but the ligament was certainly external.

Surface marked by numerous concentric striæ, and, on the central and lower portion of the shell only, by four concentric grooves or arrests of growth, of which the first and second are well defined and wide apart, and the third and fourth more obscure and closer together.

Sucia Islands, in Division A; J. Richardson, 1874. A single specimen, with the test partly preserved on both valves, but imperfect at the anal end. In the figure the outline of the posterior termination of the shell has been restored from the lines of growth, and to some extent also from the shape and markings of the cast.

Lævicardium Suciense. (N. Sp.)

Plate 18, figure 2.

Shell convex, inequilateral, obliquely and ovately subtriangular, narrowest above and widest near the base; length and height nearly equal. Anterior side short and rather broadly rounded; posterior side somewhat longer, obliquely truncated at its extremity, and bluntly pointed at its junction with the ventral border; base broadly semi-ovate, rounded in front and flatter behind. Beaks large, prominent, approximate, incurved, directed also a little forwards, and placed in advance of the middle; umbones gibbous. No well defined lunule; posterior area narrow, flattened obliquely, and margined near the beaks by an obtuse, subangular keel or ridge, which becomes obsolete long before reaching the base behind.

Surface polished, shining, marked only by minute and crowded, but

not undulating, concentric striæ, which become coarser and much more rib-like on the posterior area. Hinge teeth and muscular impressions unknown.

Length, ten lines and a quarter; height, nine lines.

Sucia Islands, in Division A, two right valves; J. Richardson, 1875.

This shell may be a variety of *Lævicardium annulatum*, Gabb,* but it is more distinctly triangular, and its concentric striæ do dot appear to be undulating or marked by "small dots, composed of circular or elliptical impressed lines arranged in radiating series," as they are said to be in that species.

Protocardium scitulum, Meek. (Sp.)

Cardium scitulum, Meek.	—Trans. Albany Inst., 1857, Vol. IV., p. 40.
Protocardia scitula, Meek.	—Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4, p. 360, pl. 3, figs. 4 and 4*a*.
?=*Leptocardia subquadrata*, Ev. & Sh. (Sp.)	—See Meek's Rep. on the Inv. Tert. and Cret. Fossils of the U. Miss. Co., p. 175, pl. 29, fig. 8, *a*, *b*, *c*, *d*, and *e*.
?=*Leptocardia rara*, Ev. & Sh. (Sp.)	—Idem, p. 176, pl. 17, figs. 1, *a*, *b* and *c*.

"Koomooks, Vancouver Island; Cretaceous." Meek. Blunden Point, V. I., two miles and a quarter and two miles and a half up the Nanaimo River, also at the Sucia Islands, in Division A; J. Richardson, 1871-75.

Mr. Meek has not failed to notice the strong resemblances that undoubtedly exist between the present species and the *Cardium subquadratum* and *C. rarum* of Evans & Shumard, from the Fort Pierre Group of Dakota. The only difference between Mr. Richardson's specimens of *P. scitulum* and the two Dakota shells that seems to be constant, is that the ribs on the posterior area of the former are distinct and strongly marked, while the corresponding costæ of the latter are either obscure, or nearly if not entirely obsolete. When the thin and polished outer layer of the test is exfoliated, which sometimes happens, the central area of the valves of *P. scitulum* appears to be concentrically ribbed, and specimens in this condition are very much like young individuals of the *C. altum* of Forbes.†

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* Palæontology of California, Vol. I., p. 171, pl. 23, fig. 152; and Vol. II., p. 187, pl. 30, fig. 81.

† Quarterly Journal of the Geological Society of London, Second Series, Vol. VII., 1846, p. 145, pl. 15, fig. 13.

Conchocele cretacea, Whiteaves.

Conchocele cretacea, Whiteaves.—Geol. Surv. Canada, Rep. Progr. 1873-74, p. 266, pl. of foss., figs. 2 and 2*a*.

Shell very inequilateral, convex, inflated, especially in the umbonal region; outline subquadrate, length nearly one fourth greater than the height; test thin. Umbones broad, tumid, anterior and terminal; beaks slender, subspiral, depressed, their apices curving downwards and a little outwards. Lunule large, ovate cordate, about one fourth higher than wide; concavely and shallowly excavated, its margin below being sharply angular, but not very prominent. Escutcheon or cardinal area very distinctly defined, broadly lanceolate as seen from above, and marked by two longitudinal and prominent keels or ridges on each valve. The two outer ones, which together form the outer boundary of the escutcheon, commence at the beaks, curve first outwards, then inwards, and finally meet at the upper termination of the posterior end. The two inner ridges both commence at the beaks, after which they each curve gently outwards, and then gradually inwards, until they meet on the cardinal border at a short distance from the posterior end. Their summits are acute, and they are each separated from the outer ridges and from the cardinal border, except at the point where they intersect the latter, by a deeply concave groove. Together they enclose a narrowly lanceolate and shorter subordinate area within the escutcheon.

Anterior margin shallowly concave under the beaks, and forming a subangular junction with the upward curve of the basal margin near or a little below the middle. Ventral border broadly rounded, curving upwards most rapidly at the posterior end, which is subtruncated and angular at its junction with the cardinal margin above. As viewed laterally, the outer ridge which bounds the escutcheon is so prominent as to hide most of the true cardinal margin from view, and in this aspect the outline of the former is slightly convex near the beaks, after which it slopes gently downwards to the upper termination of the shell posteriorly. A portion of the hinge margin, however, projects very slightly above the centre of the highest level of this ridge in the shape of a depressed but broadly convex lobe.

Surface marked by fine, subequal, concentric, raised striæ.

In the left valve the hinge appears to be composed of a single, long, sharp tooth, which runs parallel with the cardinal margin, and which extends from the beaks almost to the posterior end. In the right valve

there is a corresponding groove. Lunular margin of the valves very sharp, thin and toothless. Pallial margin simple, entire.

Length, eighteen lines; height, fourteen; thickness through the valves, twelve.

Below Dodd Narrows, V.I., in Division A; J. Richardson, 1872. Nine good specimens.

Lucina nasuta, Gabb.

Lucina nasuta, Gabb.—Pal. Cal., Vol. I, p. 175, pl. 24, fig. 159.

Sucia Islands, in Division A; J. Richardson, 1874. One small example.

A very imperfect specimen from below Dodd Narrows, V.I., which measures upwards of three inches in length and more than two in height, probably also belongs to this species.

Lucina subcircularis? Gabb.

Lucina subcircularis, Gabb.—Pal. Cal., Vol. 1, pp. 176, pl. 24, fig. 160.

Sucia Islands, in Division A; J. Richardson, 1874. A cast of the right valve, with fragments of the test preserved.

Clisocolus cordatus, Meek and Hayden. (Sp.)

Plate 18, Figures 3, 3a and 3b.

Cyprina cordata, Meek and Hayden.	—Proc. Ac. Nat. Sc. Phil., 1857, Vol. IX., p. 143.
Bucardia? Moreauensis, M. and H.	—Ib. 1860, Vol. XII., p. 426.
Glossus? Moreauensis, Gabb.	—1861, Cat. Cret. Fossils, p. 125.
Sphæriola? cordata, M. and H.	—Rep. on Inv. Cret. and Tert. Foss. U. Miss. Co., p. 137, pl. 29, figs. 3*a*, *b*, *c*.
? = *Sphæriola endotrachys*, Meek.	—Idem, p. 139, pl. 29, fig. 2.
Loripes dubia, Gabb.	—Pal. Cal., Vol. I., p. 177, pl. 24, figs. 170 and 171.
Clisocolus dubius, Gabb.	—Idem, Vol. II., p. 139, pl. 29, fig. 2.

Shell globose, very gibbous, especially in the umbonal region, higher than long, thickness through the valves about equal to the height. Sides and base rounded, the latter a little flattened; umbones broad, tumid, elevated and approximate; beaks placed a little in advance of the middle, subspiral, their apices divergent and curving outwards; no distinct lunule or posterior area.

Surface of young specimens concentrically ribbed and marked also by faint, radiating impressed lines. In adult shells the ribs almost disappear, their place being taken by coarse, irregularly disposed, concentric striations, and by a few broad, shallow and distant sulcations, the

results of former arrests of growth. At this stage of growth, too, the radiating lines become obsolete.

Pallial line entire, parallel with the base. Ligament external, lodged in a rather deep groove. Hinge teeth obsolete or nearly so. Hinge plate of the right valve swollen slightly and longitudinally under the beaks, the swelling being bounded posteriorly by a short, oblique excavation. Posterior end of the hinge plate of the left valve marked by a narrow, oblique groove, immediately under the fulcrum and parallel with it, evidently for the reception of the acute fulcral edge of the right valve.

Length of the largest specimen, twenty lines; height of the same, twenty-one lines. In another individual the length is eighteen lines, and the thickness through the valves is just equal to the length, the height being twenty lines.

Nanaimo River, V. I., two miles and a-quarter up, in Division A. A single cast. Sucia Islands, in the same Division, fourteen large and nearly perfect shells, most of them with both valves; J. Richardson, 1872 and 1875.

The specimens described above evidently belong to Mr. Gabb's genus *Clisocolus*, and are identical with the *C. dubius* of that author. Stoliczka thinks that *Clisocolus* may be synonymous with *Loripes* of Poli, but the former name may be conveniently retained for a group of fossil Lucinoid shells, some of which have been described as *Isocardiæ*, which are characterized not only by their edentulous hinge, but also by their globosely cordate shape and semispiral, divergent beaks. *Isocardia cretacea* of Goldfuss is probably a *Clisocolus*, and appears to differ from *C. dubius* only in its slightly more elongated form.

The description of "*Sphæriola* (?) *cordata*" (which Mr. Meek says "may possibly belong to an undescribed genus") applies so perfectly to the Sucia Island examples of the present species as to leave very little doubt in the writer's mind that *C. dubius* and *S. cordata* are different names for the same shell. *Sphæriola endotrachys* of Meek appears to be an elongated variety of *S. cordata*, the roughnesses on the cast of the former being probably due to a diseased condition of the mantle of the animal.

Opis Vancouverensis. (N. Sp.)

Plate 18, figures 4 and 4*a*.

Shell inequilateral, subpyriform or ovately subtrigonal, about twice as high as long, and widest near the base; test thick. Anterior side very

short, its margin broadly rounded below the middle, straighter above; posterior side short, obliquely truncated, and apparently angular or sub-angular at its junction with the ventral border below; basal margin regularly rounded in front, probably straighter behind. Umbones oblique, enormously developed: beaks situated in advance of the middle, acute, semispiral, and divergent at their apices. Behind the beaks a blunt but well defined keel or ridge extends to the base of the posterior end and separates a wide posterior area from the main body of the shell. This posterior umbonal keel is curved convexly above, but becomes much straighter below, and the posterior area, which is equal in height to the shell itself, is flattened at almost a right angle to the central portion of the valves. Lunule distinctly defined, ovate cordate in outline, not quite half the height of the shell, a little higher than broad, flatly excavated at nearly a right angle to the middle part of the valves.

Surface marked with concentric striæ of growth.

Hinge plate of the right valve (the only one known) very large, broadly triangular, and bearing in its centre a transversely elongated tooth, which is narrow and prominent above, but dilated and obliquely truncated below. On the anterior or lunular side this tooth is united to the hinge plate above, but on the posterior side it is separated from it by an oblique and probably ligamentary groove which runs parallel to the fulcrum. On either side of the tooth there is a deep, transversely elongated pit, evidently for the reception of two teeth in the left valve.

S. W. side of Denman Island, in Division B; J. Richardson, 1871. An imperfect right valve, with the surface much worn, and partly covered with the base of attachment of a living species of *Balanus*.

The lower half of the posterior margin of this specimen is badly broken, so that the exact outline of this part of the shell has yet to be ascertained. The lines of growth and the direction of the post-umbonal groove seem to indicate that the posterior margin formed a sub-angular junction with the ventral border, but it cannot be positively asserted that the base was not rounded behind. Although the characters of *O. Vancouverensis* are rather imperfectly known, yet they appear to be sufficiently intelligible to prevent it being confounded with any previously described species. In the general shape of the shell, and especially in the contour and proportionate size of the lunule and posterior area, there are many points of resemblance between it and *Opisoma Geinitziana* of Stoliczka,* but the present species is a true *Opis*, and has one tooth in the

* Cretaceous Pelecypoda of Southern India, p. 288, pl. 10, fig. 11.

right valve and two in the left, whereas in *O. Geinitziana* there are three teeth in each valve.

Astarte Conradiana, Gabb.

Plate 18, figures 5 and 5*a*.

Astarte Conradiana, Gabb.—Pal. Cal., Vol. I., p. 178, pl. 24, fig. 161.

Sucia Islands, in Division A.; J. Richardson, 1874 and 1875. Abundant, perfect and beautifully preserved.

The beaks of the Californian types of *A. Conradiana* are described as "overhanging the anterior end," but those of the specimens collected by Mr. Richardson are invariably placed at some distance from the front margin and are never quite terminal. Most of the hinge dentition is exhibited in two fragments, one of which is figured. There are two teeth in the left valve, one cardinal and the other lateral, and between the two there is a deep, oblique, triangular pit. The cardinal tooth is prominent, transverse and placed close to the lunular margin of the valve and parallel with it. The lateral tooth is elevated on the anterior half of the lower margin of the hinge plate only, and is grooved longitudinally above. In the opposite valve there is an oblique, triangular tooth immediately under the beak, but the posterior portion of the hinge of the only right valve in which the characters of the interior are exposed is too much broken to show whether there was a lateral tooth or not, or what it was like if there was.

Astarte Conradiana, var. Tuscana, Gabb.

Plate 18, figure 6.

Astarte Tuscana, Gabb. —Pal. Cal., Vol. I., p. 129, pl. 30, fig. 257.
Astarte cardinioides, Whiteaves. —Geol. Surv. Canada. Rep. Progr. 1873-74, p. 267, pl. of foss., fig. 3.
Astarte Vancouverensis, Whiteaves.—Idem, p. 267, pl. of foss., fig. 4.

North-west Bay, V. I., and at the Sucia Islands, in Division A; J Richardson, 1872 and 1874.

Mr. Richardson's specimens show clearly that *Astarte Tuscana* is only a variety of *A. Conradiana*. The posterior end of the present shell is doubtless narrower, more elongated, and more compressed laterally than it is in *A. Conradiana* proper, but in a large and fine series of both forms, from the Sucia Islands, the anterior end of each is precisely similar, as may be seen by a comparison of figures 5 and 6 on Plate 18. The types of *Astarte cardinioides* prove to be only large and badly preserved individuals of *A. Tuscana*, with their ribs worn flat under the matrix,

and *A. Vancouverensis*, also, has been found to be nothing more than an obliquely distorted specimen of *A. Tuscana*.

Trigonia Evansana, Meek.

Trigonia Evansana, Meek. —Trans. Alb. Inst., Vol. IV., p. 42.
Trigonia Evansii Gabb, as of Meek.—Pal. Cal., Vol. I., p. 189, pl. 25, fig. 177.
Trigonia Evansii, Meek. —Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4 p. 359, pl. 2, figs. 7, 7*a* and 7*b*.

"Cretaceous beds at Nanaimo, Vancouver's Island." Meek. North-west Bay, V.I., seven or eight specimens with the shell preserved, also at the Sucia Islands, a few casts, with portions of the exfoliated test attached; both in Division A; J. Richardson, 1872 and 1874.

Trigonia Tryoniana, Gabb.

Plate 18, figure 7.

Trigonia Tryoniana, Gabb.—Pal. Cal., Vol. I., p. 188, pl. 25, fig. 176.

North-west Bay, V.I., in Division A; J. Richardson, 1872. The only specimen yet obtained, which is represented in the figure, is a tolerably perfect and well preserved left valve of a local variety of *T. Tryoniana*, in which the oblique series of tubercles are unusually numerous and closely disposed.

Nucula pectinata (?) Sowerby.

Plate 18, figure 8.

Nucula pectinata, Sowerby. —Min. Conch., Vol. II., p. 207, pl. 192, figs. 6 and 7.
Nucula pectinata, Mantell. —Geol. of Sussex, pl. 19, figs. 5 and 9.
Nucula pectinata, D'Orbigny.—Pal. Franc., Terr. Cret. Vol. III., p. 178, Atlas, pl. 303, figs. 8-14.

Lower part of the Trent River, in Division B; J. Richardson, 1871. A distorted left valve, whose surface has been pressed down on, and its margin strongly indented by, a large fragment of *Entalis Cooperi* which lies obliquely under it. The crowded radiating ribs of this specimen are in every respect similar to those of *N. pectinata*, and due allowance being made for the distortion of the former, the shape of the two shells is also very nearly alike, though the beaks of the Trent River shell are placed a little farther from the posterior end than they appear to be in Sowerby's species. In Woodward's "Manual of the Mollusca," page 269, it is stated that the umbones of shells of the genus *Nucula* are "turned towards the short posterior side," and hence it would seem that the excavated space which D'Orbigny calls the lunule of *N. pectinata*, is really the posterior area or escutcheon.

Nucula (Acila) truncata, Gabb.

Nucula truncata, Gabb. —Pal. Cal., Vol. I., p. 198, pl. 26, fig. 184.
Nucula (Acila) truncata, Gabb.—Idem, Vol. II., pp. 197 and 250.

North-west side of Hornby Island, in Division D; Gabriola Island and S.W. side of Denman Island, in Division B; Nanaimo River, V. I., two miles and a quarter up, and Protection Island, in Division A; J. Richardson, 1871-75.

(Nucula Traskana, Meek.

Nucula Traskana, Meek.—Trans. Alb. Inst., 1857, Vol. V., p. 39.
Nucula Traskana, Meek.—Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4, p. 356.

Nanaimo or Comox, V. I. Meek. "A species which," Mr. Meek says, "will probably be recognized by its ventricose, trigonal-ovate form, and nearly central beaks." No shell corresponding to the descriptions of *N. Traskana* has been detected in any of Mr. Richardson's collections.)

Yoldia Striatula, Forbes. (Sp.)

Plate 18, Figure 9.

Leda striatula, Forbes. —Trans. Geol. Soc. Lond, Series 2, Vol. VII., p. 148, pl. 17 fig. 14.
Yoldia striatula, Stoliczka.—Cret. Pelecyp. S. India, p. 323, pl. 4, fig. 2, and pl. 17, fig. 6.

North-west side of Hornby Island, in Division D.; South-west side of Denman Island, in Division B.; Sucia Islands, in Division A.; J. Richardson, 1871-75.

Besides the concentric striæ of growth, the surface of the valves of this little shell is marked with minute, sub-oblique, impressed lines, which are not visible to the naked eye. These latter were carefully described and figured by Forbes, but Stoliczka did not seem to be aware of their existence, or at any rate makes no mention of them.

Axinæa Veatchii, Gabb.

Axinæa Veatchii, Gabb. Pal. Cal., Vol. I., p. 197, pl. 25, figs. 183 and 183a.

North-west side of Hornby Island, in Division D.; Blunden Point (large and common), North-West Bay (also numerous and large), and entrance to Departure Bay, V. I.; also at the Sucia Islands (where it is plentiful but usually small), in Division A.; J. Richardson, 1871–75.

(ARCA ? EQUILATERALIS, MEEK.

Arca (Cucullæa ?) equilateralis, Meek.—Trans. Alb. Inst., 1857, Vol. IV., p. 40.
Arca ? equilateralis, Meek. —Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4, p. 357, pl. 2, figs. 6 and 6*a*.

"Nanaimo (?) Vancouver Island; Cretaceous." Meek. Not obtained at any of the localities visited by Mr. Richardson.)

NEMODON VANCOUVERENSIS, MEEK. (Sp.)

Plate 19, figures 1 and 1*a*.

Arca Vancouverensis, Meek. —Trans. Alb. Inst., Vol. IV., p. 40.
Arca Breweriana, Gabb. —Pal. Cal., Vol. I., p. 193, pl. 25, fig. 181.
Grammatodon ? Vancouverensis, Meek.—Bul. Geol. and Geogr. Surv. Terr., Vol. II., No. 4, p. 356, pl. 3, figs. 5 and 5*a*.

"Koomooks, Vancouver Island; Cretaceous." Meek. South-west side of Hornby Island, in Division D; south-east end and south-west side of Denman Island, in Divisions C and B; Sable River and Blunden Point, V. I., in Division A; J. Richardson, 1871-73.

This species was described from individuals which were probably immature; for the length of the type figured by Meek is stated to be 0·75 inch, and the height 0·47. The specimens collected by Mr. Richardson, which are believed to be referable to *A. Vancouverensis*, show that the shell, when adult, attained to a length of upwards of three inches, and to a height of about twenty-two lines. The dentition of the hinge is always remarkably constant in its characters, but the outline of the valves varies considerably in different individuals. In some the hinge line and basal margin are nearly parallel, the posterior end is rather squarely truncated, and the two extremities are nearly equal in breadth. This must be regarded as the typical form, it being the one which corresponds most nearly to Meek's description and figures of *A. Vancouverensis*. In another variety the posterior side is distinctly wider than the anterior; the hinge line and basal margin are not quite parallel, but somewhat divergent, and the cardinal margin ascends gradually from the anterior to the posterior end; the ventral border rounds up rapidly in a broadly convex curve from the middle of the valves to the termination of the hinge line in front; the posterior end is obliquely truncated above and bluntly pointed below. The fine adult specimen from Blunden Point, represented on plate 19, gives a good idea of the shape of this variety, which, however, is connected with the more typical form of the species by several intermediate gradations.

The hinge plate, which is nearly as long as the shell itself, is straight above, slightly arcuate below, and widens outwards at each end. Opposite to the beaks, or a little behind them, there are a few minute, crowded, granular denticles, arranged obscurely in three obliquely ascending, but nearly transverse, rows. The whole of the teeth proper are large, elongated, horizontal and nearly parallel with the cardinal margin, but at their inner terminations they curve distinctly downwards. In the adult shell there are three or four anterior and five posterior teeth in the right valve, while in the left there are three anterior and four posterior. The anterior teeth of both valves are grooved transversely, but the posterior teeth are smooth. The nearer the teeth are to the inner margin of the hinge plate the shorter they are, and *vice versa*. The upper posterior tooth is more than half the length of the hinge line.

Mr. Meek says: "I am not well enough acquainted with the hinge of this little shell to be quite sure that it is congeneric with the form on which I proposed to found the genus *Grammatodon* in the "Palæontology of the Upper Missouri." One of the casts shows a little of the impression of the hinge in front of the beaks, with apparently four or five small teeth or denticles, ranging obliquely forward and upward." *

The hinge dentition of the sub-genus *Nemodon* is thus described by Conrad: "Hinge line long and straight, or slightly curved under the umbo; hinge in the left valve with three linear teeth parallel with the anterior cardinal margin; posterior lateral tooth double, very long, linear; under the apex a few granular teeth." † The number of posterior lateral teeth is obviously not of generic importance, depending as it does on the age or size of the shell. In *Arca Eufalensis*, the type of *Nemodon*, which is represented as about an inch in length, there appear to be two posterior teeth in the left valve. In a right valve of *A. Vancouverensis* not quite an inch and a-half long there are two long, linear furrows and one short one at the posterior end of the hinge plate, evidently for the reception of two fully developed teeth, and one rudimentary tooth in the opposite valve. There can be little doubt, therefore, that the present species should be referred to *Nemodon* rather than to *Grammatodon*.

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* Bulletin of the Geological and Geographical Survey of the Territories, Vol. 2, No. 4, p. 357

† American Journal of Conchology, Vol. V., (1870) p. 97.

Cucullæa (Idonearca) truncata, Gabb.

Plate 19, figures 2 and 2*a*.

Cucullæa truncata, Gabb. —Pal. Cal., Vol. I., p. 196, pl. 25, fig. 182.

?= *C.* (*Idonearca*) *Nebrascensis*, Owen.—See Meek's Rep. Cret. and Tert. Foss. U. Miss. Co., p. 88, pl. 29, figs. 5, *a*, *b*.

?= *C.* (*Idonearca*) *Shumardi*, M. & H.—See the same work, p. 86, pl. 28, figs. 15*a*–*g*, and pl. 29, fig. 4.

Possibly a var. of *C. glabra*, Parkinson.—For the synonymy of this species see Pictet & Campiche's Pal. Suisse, Foss. Ste. Croix, Vol. III., p. 456.

Middle Shales, Division D, of the west side of Hornby Island; Lower Shales, Division B, of Gabriola Island; Productive Coal Measures, Division A, at Nanaimo River, two miles and a-half up, and North West Bay, V. I.; also at the Sucia Islands; J. Richardson, 1871-75.

This species is subject to considerable variation, both in shape and sculpture. In some specimens the margin of the posterior end is truncated almost vertically and the posterior side is shorter than the anterior. Others have almost exactly the same outline as the "mature specimen" of *Cucullæa Nebrascensis* figured by Meek, and in these the posterior side is longer than the anterior, the former being produced and very obliquely truncated at its termination. Young shells, about an inch in length, are marked by crowded radiating ribs, which are nodulous in consequence of their being crossed by equally numerous, raised, concentric striæ. In adult individuals the radiating ribs are never nodulous, and sometimes become nearly obsolete. The left valve is invariably larger than the right. The height, as measured from the top of the beaks to the base, is usually a little less than the length, and slightly greater than the thickness through the closed valves. The test of aged shells is upwards of four lines in thickness. On the inside of the test there is a prominent, sharp ridge, which bounds the inner side of the posterior muscular impression. The hinge plate is broad at the ends and narrow in the middle; it bears three or four elongated teeth at each end, and a few rather small, transverse teeth or denticles in the centre. The lateral teeth, which are striated or grooved across, are parallel with the cardinal margin, and their inner ends are apparently not bent downwards. The central teeth or denticles are each as wide as that part of the hinge plate on which it is placed, and are not minute, granular, or arranged in two or three rows which ascend obliquely upwards and outwards, as in *Nemodon*. Some of these central denticles are little more than raised, rounded tubercles.

According to Mr. Gabb, "*C. truncata* is allied to *C. Nebrascensis*, Owen; but differs in the smaller beaks, proportionally longer form, more oblique truncation posteriorly, and in being more produced in the anterior basal region." "There is also," he adds, "a difference in the hinge. In *C. Nebrascensis* the lateral teeth radiate, as it were, from an imaginary point, while in the present species they are parallel with each other and with the upper edge of the hinge plate, and their inner ends are bent at a right angle." * Since these remarks were written Mr. Meek has published excellent new descriptions and figures of *C. Nebrascensis*, and a comparison of these with twenty more or less perfect specimens of *C. truncata* from the Vancouver Cretaceous shows that the beaks of *C. truncata* are fully as large as those of *C. Nebrascensis*, and that the hinge dentition and outline of the valves are alike in both.

There are several reasons for supposing that *Cucullæa Nebrascensis* of Owen, *C. Shumardi* of Meek & Hayden, and *C. truncata* of Gabb, have been separated as distinct species on insufficient grounds, and that all three may be mere varieties of the *C. glabra* of Parkinson, of which *C. fibrosa*, Sowerby, is generally admitted to be a synonym. At present it does not seem possible to distinguish detached immature valves of *C. truncata* from those of *C. Shumardi* or *C. fibrosa* by any known character, and *C. Nebrascensis* appears to bear the same relation to *C. Shumardi* and to *C. truncata* that *C. glabra* does to *C. fibrosa*. In *C. glabra* proper, as the name imports, and in *C. Nebrascensis*, the radiating ribs are absent or nearly so at all stages of growth, but in *C. fibrosa*, *C. Nebrascensis* and *C. truncata* they are always present, though sometimes rather obscure.

In 1860 Mr. Meek united *C. Shumardi* to *C. fibrosa*, but subsequently changed his opinion on this point, on the ground, first, that *C. fibrosa* "is a Gault and Greensand species," while *C. Shumardi* "has only been found in beds equivalent to the true chalk;" † and, secondly, because D'Orbigny states that the right valve of *C. fibrosa* is the largest of the two, whereas in *C. Shumardi* the left valve is the largest. But to these arguments it may be replied: (1) that the circumstance that *C. fibrosa* is known to occur in the Lower Greensand, Gault, and Upper Greensand of Europe, is no reason why it should not be found on the horizon of the chalk proper in America; and (2), though D'Orbigny certainly does say that the right valve of *C. fibrosa* is larger than the left, yet on figure 6 of

* Palæontology of California, Vol. I., p. 196.
† Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country, p. 87.

plate 312 of the Atlas to Volume III. of the "Terrains Crétacés," which is described as a cast of *C. fibrosa*, viewed at the buccal side, the left valve is unquestionably represented as the largest.

It is, however, only proper to add that in an adult specimen of *C. glabra* figured by D'Orbigny the length is one-third greater than the height, whereas in *C. truncata* and *C. Nebrascensis* the height and length are often nearly equal, and in the most elongated specimens of the latter yet collected, the length is only one-sixth greater than the height.

Mytilus pauperculus, Gabb.

Mytilus pauperculus, Gabb. —Pal. Cal., Vol. I, p. 183, pl. 25, fig. 165.
Compare *M. subarcuatus*, Meek & Hayden. —See Meek's Rep. on Inv. Cret. & Tert. Foss. U. Miss. Co., p. 69, pl. 38, figs. 2*a*, *b*.

Sucia Islands, in Division A; J. Richardson, 1874. A single right valve, rather more than half-an-inch long. The specimen is higher and not quite so much elongated as the California shell figured by Gabb, but probably belongs to the same species.

Modiola ornata, Gabb.

Modiola ornata, Gabb.—Pal. Cal., Vol. I., p. 184, pl. 24, fig. 166.

N. W. Side of Hornby Island, in Division D, and at the Sucia Islands, in Division A; J. Richardson, 1871-74. A small and imperfect valve from each locality. Closely allied to *Modiola pedernalis*, Rœmer, from the Cretaceous rocks of Texas, but the two species may be easily distinguished by the position of the beaks, which are terminal in *M. pedernalis* and subterminal in *M. ornata*. Both belong to Swainson's sub-genus *Brachydontes*.

Pinna calamitoides, Shumard.

Plate 20, figures 1, 1*a* and 1*b*.

Pinna calamitoides, Shumard.—Trans. Ac. Sc. St Louis, 1858, Vol. I., p. 124.

"Shell elongated, triangular, compressed, slightly curved, umbones rounded; buccal portion attenuated; ligament margin acute, arcuate; pallial margin gently concave; surface marked with about fourteen slender, rounded, longitudinal ribs, separated by much wider spaces than the ribs. On the ligamental side of the shell these ribs are quite distinct, regular and nearly equidistant, but on the pallial portion they are partially effaced and assume the form of irregular and rather broad folds."

"Dimensions.—Apicial angle, 28°; at the distance of about two inches from the point of the beak the width is 13 lines, and the thickness 6 lines."

"A single specimen only of this shell has come under my observation. It is somewhat mutilated, the extremities being broken off and the surface more or less exfoliated. An examination of more perfect individuals may therefore render it necessary to slightly modify the above description."

"For. and Loc.—Cretaceous formation of Nanaimo River, Vancouver Island. The fragment of rock in which the specimen was embedded is a dark, greenish, argillaceous, sandy-textured limestone, with dark, igneous pebbles disseminated through it." Shumard.

Six well-preserved fragments of this species were collected by Mr. Richardson in 1874, at the Sucia Islands, in Division A, but they give very little additional information as to its characters. The cardinal margin and the shell itself both seem to be straight and not arcuate or curved, and the outline of a portion very near to the anterior termination of the valves, indicates that the beaks were probably narrow and acute rather than rounded. *Pinna Breweriana* of Gabb, from the Chico Group of California, is very closely allied to the present shell, and may prove to be identical with it.

(Meleagrina antiqua, Gabb.

Meleagrina antiqua, Gabb.—Pal. Cal., Vol. II., p. 192, pl. 31, fig. 89.

"From Departure Bay, Nanaimo, Vancouver Island, associated with *Trigonia Evansana*, *Pecten Traskii*, and other fossils equally characteristic of the Chico Group." Gabb. No specimens of this shell were collected by Mr. Richardson.)

Inoceramus undulato-plicatus, Rœmer.

Plate 20, figures 2 and 2*a*.

Inoceramus undulato-plicatus, Rœmer.—Die Kreidebildungen von Texas (1852) p. 59, pl. 7, fig. I.

"Testa oblique ovata, subtetragona, parum convexa, concentrice irregulariter striata, radiatim undulato-plicata; plicis latis, parum elevatis, subnodosis, a linea testæ diagonali ad peripheriam divergentibus, subarcuatis. Strato superiore fibroso testæ tenui." At the waterfall of the Guadalupe below New-Braunfels, Texas. Rœmer.

"Septarian clays at Nanaimo and Valdez Inlet:" Etheridge. Lower Shales, Division B, at Sable River, V. I., not very common; Productive Coal Measures, Division A, at Blunden Point and North West Bay, V. I., abundant, perfect, and in fine condition; J. Richardson, 1871 and 1872.

A peculiarly sculptured shell, not likely to be mistaken for any

described European species. On a cursory examination the markings of its valves remind one, in a general way, of those of *Plicatula*, or of some species of *Alectryonia*. The folds diverge downwards and outwards to the lateral margins on either side, the points of divergence being coincident with an oblique line which might be drawn from the posterior side of the beaks to the centre of the opposite extremity. In some specimens the folds, whose summits are invariably rounded, are prominent and distant; in others they are not so much elevated, and closer together. The largest individual collected by Mr. Richardson is fully five inches and a half in height, from the summit of the beaks to the opposite margin.

Inoceramus mytilopsis, Conrad.

Plate 20, figure 3.

Inoceramus mytiloides, Rœmer.—Die Kreidebildungen von Texas, p. 60, pl. 7, fig. 5 (As of Mantell.)

Inoceramus mytilopsis, Conrad.—Emory's Rep. U. S. and Mex. Bound. Surv., Vol I., p. 152, pl. 5, figs. 6*a*, *b*.

Texas: Rœmer and Conrad. Septarian clays at Nanaimo and Valdez Inlet; Etheridge. Trent River, V. I., above and below the falls, also Bradley Creek, in Division B; J. Richardson, 1871.

As will be seen by the synonymy above quoted, Dr. Ferdinand Rœmer has identified this shell with the *Inoceramus mytiloides* of Mantell, which most palæontologists have united to the widely distributed *I. problematicus* of Schlotheim, while Conrad regards it as a distinct species. The Trent River specimens of *I. mytilopsis* are in all respects similar to the Texan shell figured by Rœmer, and both differ from the typical form of *I. mytiloides* or *I. problematicus* in their proportionately longer hinge line, which runs much more nearly parallel with the longest axis of the valves, also in their more closely arranged and more regular concentric folds, which might justly be described as ribs. The anterior border of most individuals is truncated inwardly and obliquely beneath the beaks, and the posterior portion of the pallial border is nearly straight, so that the margin of the lower half of the shell is subangular in the middle; the posterior extremity also is subtruncated. These latter characters, however, are not constant, for in one or two of the Vancouver examples of *I. mytilopsis* the margin of the lower half of the shell is not subangular in the middle, but forms a broadly rounded semiovate curve which extends from the beaks to the termination of the posterior end below, and the hinder extremity is narrowly rounded.

In the comparative length of its hinge line, this *Inoceramus* somewhat resembles the Nebraska variety of *I. problematicus* described and figured by Meek as *I. problematicus, var. aviculoides.**

Inoceramus Vancouverensis, Shumard.

Plate 20, figures 4, 4*a* and 4*b*.

Inoceramus Vancouverensis, Shumard.	—Trans. Ac. Sc. St. Louis, Vol. I., (1858) p. 123.
?=*Inoceramus Elliotii*, Gabb.	—Pal. Cal. Vol. II., (1869) p. 193, pl. 31, fig. 90*a*.
?=*Inoceramus altus*, Meek.	—Hayden's Rep. Geol. Surv. Terr., 1871, p. 302.
" " " "	—Rep. Inv. Cret. and Tert. Foss. U. Miss. Co., p. 43, pl. 14, figs. 1*a*, *b*.

Compare *Inoceramus propinquus*, Munster.—Goldfuss. Petr. Germ. Vol. II, (1840) p. 112, pl. 109, figs. 9*a*, *b*.

"Shell large, ovate subquadrate, not very oblique, gibbous and sloping gradually but somewhat irregularly to the basal margin, height equal to or greater than the length; cardinal margin straight or very slightly arched; buccal and basal margins regularly rounded, and forming together nearly a semicircle; anal side lengthened, its margin gently arched, and forming, with the cardinal margin, rather more than a right angle; umbo very ventricose above; beaks directed obliquely forward, incurved, very elevated, obtusely pointed, situated nearest the buccal margin; surface marked with broad, rounded, unequal concentric folds, and fine, nearly equidistant, slightly prominent concentric lines. In very young specimens a few longitudinal striæ are to be seen passing over the umbo, which, in most specimens in the collection, becomes suddenly very ventricose, and forms a circumscribed, ovate tumor. In other specimens, however, although there is a swelling of this part of the shell, it does not rise so abruptly from the general surface. This latter variety of our shell resembles somewhat *Inoceramus convexus* (Hall & Meek), from which it is easily distinguished by the concentric lines of the surface, which are much wider apart. The *I. Vancouverensis* is also much less oblique, and this character also separates it from *I. Sagensis* (Owen), to which it bears some resemblance."

"Dimensions.—The measurements of the best specimen in the collection are—length, four inches; height, four inches; thickness of left valve,

* Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country, p. 63, pl. 9, fig. 4.

three-quarters of an inch. There are, however, some fragments which show that this species attains a much greater size, perhaps more than double the dimensions here given."

"Form. and Loc.—Occurs in the dark argillaceous, compact limestone of Nanaimo River, Vancouver's Island."–Shumard.

Nanaimo River, two miles and a quarter up, Protection and Saturna Islands; Vesuvius Bay on Salt Spring or Admiralty Island; in Division A; a few, not very good specimens from each of these localities. Sucia Islands, also in Division A, ninety-five examples, many of which are well preserved and nearly perfect; J. Richardson, 1871-75.

In about ninety or ninety-five per cent. of the specimens of *I. Vancouverensis* collected by Mr. Richardson, the height of the shell is manifestly greater than its length. The margin of the buccal side of this prevalent form of the species, though broadly rounded in some individuals, is straight or truncated almost vertically in others, and these latter shells can scarcely be distinguished from the *I. altus* of Meek. *I. Elliotii* of Gabb appears also to be possibly synonymous with *I. Vancouverensis*. It is quite likely that the present species may prove to be identical with the *I. propinquus* of Munster, which Eichwald, Geinitz, Pictet and Stoliczka regard as a large variety of *I. problematicus*, Schlotheim. Goldfuss' description and figures of *I. propinquus* apply remarkably well to most specimens of *I. Vancouverensis*, though, as a general rule, the concentric plications of the latter shell are generally more prominent, distant and regular than they are represented as being in *I. propinquus*.

A few exceptional specimens of *I. Vancouverensis* broaden rapidly below the middle, so that the maximum length of the shell equals, or even exceeds the height. It was probably this form of species that Dr. Shumard had in view when he compared it with *I. convexus* and *I. Sagensis*. *I. convexus*, however, has a long hinge line, which is nearly parallel with the longer diameter of the valves and belongs, therefore, to the sub-genus *Catillus:* Zittel and Pictet both think it may be a variety of *I. Crippsi*. *I. Vancouverensis*, on the other hand, always has a short hinge line, and is a typical *Inoceramus*, in the sense in which that genus has recently been restricted and redefined by Meek.

Some specimens of the broad, short variety of *I. Vancouverensis* approach rather near to *I. Nebrascensis*, var. *Sagensis*, so far as the general outline of the valves is concerned, but Mr. Meek says that the beaks of the latter shell do not rise much above the hinge margin, and are scarcely incurved, whereas those of *I. Vancouverensis* are both prominent

and very decidedly curved inwards. The extraordinary protuberance of the umbones in some individuals of this species, to which reference is made by Dr. Shumard, appears to the writer to be due to a distortion of the shell at an early stage of growth.

INOCERAMUS NEBRASCENSIS, VAR SAGENSIS.

Inoceramus Nebrascensis, Owen. —Rep. Geol. Minnesota, Iowa and Wisconsin, (1852) p. 582, pl. 8, fig. 1.

Inoceramus Sagensis, Owen. —Ib., pl. 7, fig. 3.

Inoceramus Sagensis, var *Nebrascensis, Meek.*—Rep. Inv. Tert. and Cret. Foss. U. Miss. Co., p. 52, pl. 13, figs. 2*a*, *b*.

"Septarian clays at Nanaimo and Valdez Inlet;" Etheridge. Sucia Islands, in Division A; J. Richardson, 1874. A single right valve, measuring about four inches and a quarter in length, by three inches and three quarters in height.

(INOCERAMUS TEXANUS, CONRAD.

Inoceramus Texanus, Conrad.—Emory's Rep. on the U. S. and Mex. Bound. Surv., Vol, I., (1857) p. 152, pl. 5, fig. 7.

"Septarian clays at Nanaimo and Valdez Inlet;" Etheridge. An imperfectly characterized species, not identified as occurring in any of Mr. Richardson's collections.")

INOCERAMUS CRIPPSII, VAR PROXIMUS.

Inoceramus proximus, Tuomey. —Proc. Ac. Nat. Sc. Phil., 1854, Vol. VII. p. 171.

Inoceramus subundatus, Meek. —Id., 1861, Vol. XIII., p. 315.

I. proximus, Tuomey ? Meek. —Rep. Inv. Tert. and Cret. Foss. U. Miss. Co., (1876) p. 53, pl. 12, figs. 7*a*, *b*.

" " " " *var subcircularis*, Meek.—Ib. p. 55, pl. 12, figs. 2*a*, *b*.

I. Crippsii, var subundatus, Meek. —Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4, (1876) p. 358, pl. 3, figs. 1 and 1*a*, but perhaps not figs. 3 nor 3*a* of the same plate.

?=I. Whitneyi, Gabb. —Pal. Cal., Vol. II., (1869) p. 193, pl. 32, fig. 91.

Lower part of the Trent River, in Division B; Nanaimo River, two miles and a quarter up, and Blunden Point, V.I., also at the Sucia Islands, in Division A; J. Richardson, 1871-74.

The writer feels satisfied that the *I.proximus* from Mississippi, Alabama and the Upper Missouri Country cannot be satisfactorily separated from the *I. subundatus* of Vancouver Island, even as a tolerably well marked

variety. *I. Whitneyi* of Gabb, from the Chico Group of California, appears to be more like the type of *I. Crippsii* as figured by European writers, and differs from the present shell only in its somewhat greater length in proportion to its height, and in its slightly more prominent beaks.

Inoceramus Crippsii, var. Suciensis.

Inoceramus Crippsii, var subundatus, Meek. (in part.)—Bul. Geol. and Geogr. Surv. of Terr., Vol. II., No. 4, pl. 3, figs. 3, 3*a*, but not figs. 1 and 1*a* of the same plate.

Shell tranversely subovate, not much longer than high; anterior side wider as well as much shorter than the posterior; posterior side somewhat produced, narrowing rapidly upwards from below, and obliquely subtruncate at the end; ventral border gibbous a little in advance of the middle; umbones prominent, beaks acute.

"Sucia Islands; Cretaceous." Meek. S. W. side of Denman Island, in Division B; J. Richardson, 1871. A detached right valve, with portions of both layers of the test preserved.

This and the preceding shell both appear to be short and broad forms of *I. Crippsii*, but in the variety *proximus*, (or *subelongatus*) the posterior side is wider than the anterior, and the umbones are not prominent. Mr. Meek's figures on plate 3 of Vol. II., No. 4, of the Bulletin of the Geological and Geographical Survey of the Territories give a very correct idea of the outline of the valves, and of the relative proportions of the umbones in both varieties; but it is worthy of note that the right valve of the *var. Suciensis*, from Denman Island, is much more inflated than it is represented as being in the specimen figured by Mr. Meek, and that the concentric folds of the former are nearly obsolete.

Inoceramus Crippsii, var. Barabini.

Inoceramus Barabini, Morton. —Syn. Org. Rem., (1834) p. 62, pl. 17, fig. 3.
Inoceramus gibbus, Tuomey. —Proc. Ac. Nat. Sc. Phil., (1854) Vol. VII., p. 170.
Inoceramus cuneatus, Meek & Hayden. —1860, Ib., p. 181.
Inoceramus Crippsii? var. *Barabini*, Morton.—Meek. Rep. Inv. Tert. and Cret. Foss. U. Miss. Co., p. 49, pl. 12, fig. 3, pl. 13, figs. 1*a*, *b* and *c*, also woodcuts Nos. 1 and 2 on p. 50.

New Jersey, Morton; Alabama, Tuomey; Yellowstone River, Mon-

tana; Meek. Sucia Islands, in Division A; J. Richardson, 1874. Six good specimens.

This is the oblique, transversely elongated, and narrowly subovate form of the species, which is regarded by Meek as the type of Morton's *I. Barabini.*

(INOCERAMUS CONFERTIM-ANNULATUS, RŒMER.

Inoceramus confertim-annulatus, Rœmer.—Die Kreidebildungen von Texas (1852), p. 59, pl. 7, fig. 4.

" " " Conrad, in Emory's Rep. on the U. S. and Mex. Bound. Surv., Vol. I., (1857) p. 151, pl. 5, fig. 5.

"Nanaimo and Valdez Inlet." Etheridge. Apparently a compressed variety of *I. Crippsii*, with close set, numerous, concentric undulations. No specimens were collected by Mr. Richardson which accord precisely with the descriptions and figures of Rœmer's species.)

LIMA MULTIRADIATA? GABB.

Lima multiradiata, Gabb.—Pal. Cal., Vol. II., p. 201, pl. 33, fig. 101.

Entrance to Departure Bay, in Division A; J. Richardson, 1871.

An imperfect cast of both valves of a rather large *Lima* of the *Plagiostoma* group, which may possibly be referable to the species mentioned above, but which is not in a condition to be determined with much certainty. On the cast of the left valve between thirty-five and forty acute, somewhat sinuated, radiating ribs may be counted, which are separated by rather wider and shallowly concave interspaces, but on fragments of the rather thick test which still adhere to the cast of the right valve the ribs are nearly obsolete, though the lines of growth are well marked.

(PECTEN TRASKII, GABB.

Pecten Traskii, Gabb.—Pal. Cal., Vol. I., p. 200, pl. 26, fig. 187, and Vol. II., p. 198, pl. 32, fig. 95.

"North shore of Departure Bay, near Nanaimo, Vancouver Island." Gabb. A fragment of a valve of a *Pecten* collected at the same locality by Mr. Richardson in 1871 may belong to this species, but only the inner surface of the test is visible, the exterior being completely buried in the tough, tenacious matrix.)

Hinnites, or Spondylus. (Sp. undt.)

Entrance to Departure Bay, V. I., in Division A; J. Richardson, 1871. Two very imperfect single valves.

Exogyra. (Sp. undt.)

Entrance to Departure Bay, V. I., in Division A; J. Richardson, 1871.

An upper valve, rather more than an inch and a-half in height and a little less than an inch in length, but imperfect round the margin, and with the test exfoliated.

Its shape is essentially the same as that of the corresponding valve of the *E. parasitica* of Gabb* and the *E. interrupta* of Conrad,† both of which are possibly varietal forms of the *E. haliotoidea* of Sowerby and other European writers. These three shells have one character in common, namely, that the keel or ridge on the upper valve, which extends in a gradually uncoiling spiral from the beaks to the base, is marginal or very nearly so; whereas in the specimen now under consideration the central and lower portions of the keel are separated from the outer edge of the valve by a rather wide space.

Ostræa. (Sp. undt.)

Entrance to Departure Bay, V. I., in Division A; J. Richardson, 1871. Fragments only of a very large, massive species, whose test is eleven lines, or nearly an inch in thickness in the middle. The outer surface of the shell is either exfoliated or else buried under the rock.

Anomia Vancouverensis, Gabb.

Plate 20, figures 5, 5*a*, 5*b*, 5*c* and 5*d*.

Anomia Vancouverensis, Gabb.—Pal Cal., Vol. II., p. 202, pl. 33, fig. 102.
Compare *Anomia lineata*, Gabb.—Ib., Vol. I., p. 203, pl. 26, fig. 193.

Two species of *Anomia* are described and figured in the "Palæontology of California." The first of these is the *Anomia lineata*, of which only the upper valve is known, and which is stated to be common at several localities in California, in the Chico Group. Its principal characters are summarized by Mr. Gabb as follows: "Shell thin, variable in shape; commonest form subcircular, often obliquely truncated on the right side;

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* Palæontology of California, vol. I., p. 205, pl. 26, figs. 192a, b, and pl. 31, fig. 273a.

† Journal of the Academy of Natural Sciences of Philadelphia, Vol. 3, Second Series, p. 330, pl. 34, fig. 15.

beak of upper valve small, distinct, marginal or submarginal. Surface marked by fine, linear, radiating ribs, often dichotomous, sometimes laterally undulated and crossed by concentric lines of growth, which sometimes become squamose. Muscular scar large. Under valve unknown." The second is the *A. Vancouverensis*, from "Departure Bay, near Nanaimo," of which only the lower valve has been obtained, which is thus described by Mr. Gabb: "Shell circular, thin; upper valve unknown; lower valve flat, marked by strong lines of growth and by very faint radiating lines; aperture elongated, oblique, occupying nearly a third of the diameter of the shell. Diameter one inch." Mr. Gabb also remarks: "It is not impossible that this may prove to be the under valve of *A. lineata*, nob., which belongs to the same group in the same formation, and of which the lower valve is unknown."

Pieces of the blackish or dark bluish-grey shales of Division B, collected by Mr. Richardson in 1871 on the banks of the Trent River, V. I., above the falls, are full of detached upper valves of a species of *Anomia*, which the writer has very little hesitation in referring to *A. Vancouverensis*. Upwards of sixty or seventy more or less perfect specimens have been obtained, and many were unavoidably broken in splitting up the pieces of shale in which they were imbedded, but not a vestige could be discovered of the lower or perforated valve, although it was carefully searched for. The upper valve is convex or compressed-convex: its outline is very variable, the most common form being transversely ovate; the right side being produced and narrowly rounded at the end, while the left side is short and broadly rounded at the margin. Some specimens are more elongated transversely than others, but the length is always greater than the height. The beaks, which are small, marginal, and not much elevated, are situated at varying distances between the centre and the left margin, but are sometimes placed very near the latter. The concentric striæ of the surface are well marked, even on the cast, and where the test is preserved, which is not often the case, it is covered externally with exceedingly minute and flexuous or bent, radiating striæ, which are too small to be seen with the naked eye, and which can only be defined clearly by the use of a somewhat powerful simple lens. Besides their own proper sculpture, these upper valves are often impressed with the fine or coarse ribbing, as the case may be, of other shells to which they were formerly attached, the most abundant species with which they are associated being *Ptychoceras Vancouverense* and *Inoceramus mytilopsis*.

If the specimens last described are really the upper valves of *A.*

Vancouverensis, it would seem that the only difference between that species and *A. lineata* is, that in the latter shell the radiating markings are somewhat coarser than they are in the former; for in Mr. Gabb's figure of *A. lineata* the "fine, linear, radiating ribs" are represented as plainly visible to the naked eye.

BRACHIOPODA.

Terebratula Wacoensis, Rœmer.

Terebratula Wacoensis, Rœmer.—Die Kreidebildungen Von Texas, p. 81, pl. 6, figs. 2, *a*, *b*, *c*.

Banks of the Trent River, V.I., in Division B; J. Richardson, 1871. A well preserved and nearly perfect cast.

Rhynchonella. (Sp. undt.)

Sucia Islands, in Division A; J. Richardson, 1874. One nearly perfect but immature specimen, which is little more than a cast, and two or three detached valves in an equally bad state of preservation.

A rather coarsely ribbed species, with a shallow and indistinctly defined mesial fold and sinus. The height and length of the shell appear to be very nearly equal. The beak of the ventral valve is large and prominent, and the number of ribs in the largest specimen collected is about twenty.

Discina Vancouverensis. (N. Sp.)

Plate 20, figure 6.

Upper valve, the only one known, large, depressed-conical, its margin nearly circular in outline, but narrowing very slightly behind; apex not very prominent nor much raised, placed a little on the posterior side of the middle, but very nearly central. Surface marked apparently with regularly-disposed, nearly equi-distant, concentric striations, or raised lines of growth.

Greatest diameter, about an inch and a quarter.

S. W. Side of Ganges Harbour, on Salt Spring or Admiralty Island, in Division A; J. Richardson, 1874. An imperfect upper valve with the surface water-worn, and consequently with the finer surface markings obliterated.

ANTHOZOA.

Smilotrochus (?) Vancouverensis. (N. Sp.)

Plate 20, figures 7 and 7*a*.

Corallum small, shortly and broadly conical, not much higher than wide, slightly curved, transverse section nearly circular in outline, upper margin oblique, sides spreading and rapidly divergent, base acute. Calyx apparently rather shallow, septa about thirty, extending from the outer wall to within a short distance of the centre. Surface marked with crowded, smooth (?) radiating ribs.

Greatest height, five lines; breadth at the top, four lines.

S. W. side of Hornby Island, in Division D; J. Richardson, 1871. A single, imperfect and badly preserved specimen.

The surface markings are not well shewn, and the upper margin of the coral is partly broken away. The ribs and septa both appear to have been smooth, and neither seem to have been elevated above, or to have projected beyond, the upper margin of the coral. The septa are so crushed and distorted that it is impossible to make out their cyclical arrangement, but they appear to have been grouped originally in pairs, which coalesce or unite at their inner terminations, and which alternate with simple, entire septa.

Platytrochus speciosus, of Gabb and Horn,* is straighter than the present species, its upper margin is more nearly horizontal, and its septa and costæ are said to be both granulous and exsert.

Smilotrochus curtus,† of the Chico Group of California, has "the base rounded or very blunt," and the "sides but slightly diverging."

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* "Journal of the Academy of Natural Sciences of Philadelphia," New Series, Vol. IV., p. 399, pl. 69, figs. 15-17.

† "Palæontology of California," Vol. II., p. 205, pl. 34, figs. 106 and 106*a*.

CONCLUSION.

With the exception of a few fragmentary remains of plants, the whole of the fossils collected by Mr. Richardson are from the lower part of the formation, or, to speak more accurately, from Divisions A to D (inclusive) of the Comox area, and from Divisions A and B of the Nanaimo Coal-field and its outlier in the Cowitchen district. The following table has been constructed to show the range of each species or well-marked variety in these lower and subordinate divisions of this part of the Vancouver Cretaceous, and in the four larger groups into which the entire series of the Cretaceous rocks of California has been divided by Mr. Gabb. The list in the centre contains the names of ninety-four species, seventeen of which are new to science, and five named varieties: six species out of the hundred mentioned on page 94 being represented by specimens which are too imperfect to be identified with a reasonable degree of probability.

Vancouver Cretaceous.				Names of Species in Mr. Richardson's Collections.	California Cretaceous.			
A.	B.	C.	D.		Shasta Group.	Chico Group.	Martinez Group.	Tejon Group.
				CEPHALOPODA.				
*				Nautilus Suciensis				
*			*	" Campbelli				
*	*		*	Heteroceras Conradi				
*	*			Ammonites Gardeni				
*				" Vancouverensis				
*				" Velledæ	?			
*				" Selwynianus				
	*		*	" Indra				
*	*			" complexus, var. Suciensis		*		
*	*		*	" Newberryanus				
9	5		4	(*Carried forward*)		1		

Vancouver Cretaceous.				Names of Species in Mr. Richardson's Collections.	California Cretaceous.			
A.	B.	C.	D.		Shasta Group.	Chico Group.	Martinez Group.	Tejon Group.
9	5		4	.....(*Brought forward*).....		1		
		*		Ammonites Jukesii				
*				Hamites cylindraceus.....				
	*			Ptychoceras Vancouverense.....				
*	*			Baculites Chicoensis?.....		?	?	
*			*	" occidentalis.....				
				GASTEROPODA.				
*				Surcula Suciensis				
*			*	" raricostata				*
*	*		*	Fulguraria Navarroensis.....		*		
*				Fusus Kingii.....		*		
			*	Serrifusus Dakotensis, var. Vancouverensis				
*			*	Perissolax brevirostris.....		*	*	
	*			Littorina compacta.....		*		
*	*		*	Potamides tenuis.....		*		
*			*	" " var. Nanaimoensis....				
*	*			Cerithium Lallierianum, var. Suciense.				
	*			Tessarolax distorta.....		*		
*				Anchura stenoptera.....				
*				" exilis			*	
*				Amauropsis Suciensis.....				
*	*		*	Gyrodes excavata.....		?		
*	*			Sycodes glaber.....		*		
*				Hindsia nodulosa.....				
26	14	1	12	.....(*Carried forward*).....		8	2	1

Vancouver Cretaceous.				Names of Species in Mr. Richardson's Collections.	California Cretaceous.			
A.	B.	C.	D.		Shasta Group.	Chico Group.	Martinez Group.	Tejon Group.
26	14	1	12	..... (*Brought forward*).....		8	2	1
*				Cirsotrema tenuisculptum.....				
*				Opalia Mathewsonii				*
*			*	Margarita ornatissima.....		*		
*				Stomatia Suciensis.....				
*				" " var. carinifera.....				
	*			Anisomyon Meekii?.....	?			
*	*		*	Cinulia obliqua.....		*		
*				Cinuliopsis typica.....				
*	*		*	Haminea Hornii.....				*
*	*		*	Dentalium Nanaimoense.....		?		
				(?= D. stramineum, Gabb.)				
*	*		*	Entalis Cooperi.....		*	*	*
				LAMELLIBRANCHIATA.				
*	*			Teredo Suciensis.....				
*				Martesia clausa.....		*	*	*
			*	Corbula Traskii?.....		?		
			*	" minima				
*				Periploma suborbiculatum.....				
*				Anatina sulcatina.....				
	*			" Tryoniana. (Loose, J. R.).....		*		
*				Thracia subtruncata.....				
*	*			Pholadomya Royana.....		*		
*				Homomya concentrica.....		*		
*	*		*	Cymbophora Ashburnerii		*	*	*
44	23	1	20	.....(*Carried forward*).....		16	5	6

Vancouver Cretaceous.				Names of Species in Mr. Richardson's Collections.	California Cretaceous.			
A.	B.	C.	D.		Shasta Group.	Chico Group.	Martinez Group.	Tejon Group.
44	23	1	20	.....(*Brought forward*)		16	5	6
*	*		*	Mactra Warrenana		?		
				(?=Smooth var. of C. Ashburnerii.)				
*				Tellina Mathewsonii		*		
			*	" quadrata.....		*		
*	*			" occidentalis (Meek not Morton.).				
*				Linearia Suciensis.....				
	*			Linearia (Leiothyris) Meekana.....				
*			*	Callista laciniata.....				
*			*	Caryatis plana.....		*		
*				Dosinia gyrata.....				*
*				Eriphyla umbonata		*		
*			*	Cyprimeria lens.....		*		
*			*	Thetiopsis circularis.....				
*				Veniella crassa				
*			*	Lævicardium Suciense.....				
*				Protocardium scitulum.....				
*				Conchocele cretacea.....				
*				Lucina nasuta.....			*	
*				" subcircularis.....		*		
*				Clisocolus cordatus.....		*		
	*			Opis Vancouverensis.....				
*				Astarte Conradiana.....		*		
*			*	" " var. Tuscana.....		*		
*				Trigonia Evansana.....		*		
64	27	1	28	.....(*Carried forward*).....		26	6	7

Vancouver Cretaceous.				Names of Species in Mr. Richardson's Collections.	California Cretaceous.			
A.	B.	C.	D.		Shasta Group.	Chico Group.	Martinez Group.	Tejon Group.
64	27	1	28	.....(*Brought forward*).....		26	6	7
*				Trigonia Tryoniana.....		*		
	*			Nucula pectinata?.....				
*	*		*	" truncata		*	*	*
*	*		*	Yoldia striatula.....				
*	*		*	Axinæa Veatchii.....		*	*	
*	*	*	*	Nemodon Vancouverensis.....		*		
*	*		*	Cucullæa truncata.....		*		
*	*		*	Mytilus pauperculus.....			*	
*			*	Modiola ornata.....				*
*				Pinna calamitoides		?		
				(?=P. Brewerii, Gabb)				
*	*			Inoceramus undulato-plicatus.....				
	*			" mytilopsis.....				
*				" Vancouverensis		?		
				(?=I. Elliotii, Gabb.)				
*				" Nebrascensis, var. Sagensis.				
*	*			" Crippsii, var. proximus.....		?		
				(?=I. Whitneyi, Gabb.)				
*	*			" Crippsii, var. Suciensis.....				
*				" " var. Barabini.....				
*				Lima multiradiata?.....		?		
	*			Anomia Vancouverensis.....		?		
				(?=A. lineata, Gabb.)				
80	39	2	35	.....(*Carried forward*).....		31	9	9

Vancouver Cretaceous.				Names of Species in Mr. Richardson's Collections.	California Cretaceous.			
A.	B.	C.	D.		Shasta Group.	Chico Group.	Martinez Group.	Tejon Group.
80	39	2	35	.....(*Brought forward*).....		31	9	9
				BRACHIOPODA.				
	*			Terebratula Wacoensis.....				
*				Discina Vancouverensis.....				
				ANTHOZOA.				
			*	Smilotrochus Vancouverensis.....				
81	40	2	36	.....(*Total*).....		31	9	9

An analysis of the columns on the left hand side of this table shows that forty-two species or varietal forms, or considerably more than one-third of the whole, are common to two or more of Mr. Richardson's divisions.

It has already been remarked that by far the largest number of species are from the Productive Coal Measures, or Division A. These deposits, which seem to be peculiarly favourable to the preservation of the shells of mollusca, &c., occupy a much greater superficial area than all the rest of the formation, and have been examined with special care in consequence of their economic importance. In the Cowitchen area, however, they have so far only yielded a few good specimens of *Heteroceras Conradi*, an undetermined species of *Inoceramus*, and some fossil plants.

The Lower Shales (Division B) appear at the surface only on or near the shores of Baynes' Sound on Vancouver and Denman Islands in the Comox district, and on Gabriola Island in the Nanaimo area.

The Lower Conglomerates (Division C) have been observed only at one locality on the east side of Denman Island and on Norris Rock. The extreme paucity of fossils in these conglomerates seems to be partly due to the limited extent of the exposures of the latter, and partly, also, to the fact that this part of the series is largely made up of fragments of the underlying and mostly crystalline, non-fossiliferous rocks.

All the fossils yet collected from the Middle Shales (Division D) are from the west side of Hornby Island, though the supposed equivalents

of these shales have been recognized also on Gabriola, Valdez and Galiano Islands.

No remains of any characteristic vertebrata or invertebrata have yet been found in the three upper Divisions. E, F and G, of the Comox Coal Field, or in Divisions C to G, inclusive, of the Nanaimo district.* Yet, as the whole of these Divisions, from A to G, inclusive, lie conformably the one on the other, in regular succession, it is at least highly probable that they all belong to the same formation.

Turning next to the columns on the right hand side of the table it will be seen that at least one species of Cephalopoda, ten of Gasteropoda and nineteen of Lamellibranchiata, collected by Mr. Richardson, occur also in the Chico Group of California, and that about nine per cent. of the fossils in the list are common to the Coal-bearing rocks of Vancouver and to the Martinez and Tejon Groups.

In the second volume of the Palæontology of California, Prof. Whitney and Mr. Gabb maintain that the coal-bearing formation of Vancouver Island is of the same age as the Chico Group, and this is no doubt true as regards Divisions A and B of the Comox and Nanaimo districts, which were the only parts of the formation that had been examined at that time. Mr. Richardson's collections show that the Productive Coal Measures of the Cowitchen area and Divisions C and D of the Comox Coal field also form part of the same north-westerly continuation and modification of the Chico Group.

The Martinez is now generally regarded as only a local sub-division of the Chico Group, of which it forms the uppermost member. It will be noticed that seven out of nine Martinez species collected by Mr. Richardson in the Vancouver Cretaceous occur also in the Chico Group.

Mr. Conrad has claimed that the Tejon Group is of Eocene age, but in the Nanaimo and Comox districts nine well known Tejon species occur in rocks which hold unquestionable Cretaceous fossils, such as *Ammonites* and *Baculites*.

In California, the Chico Group, (with the Martinez,) probably represents the Lower and Upper Chalk of Europe, while, according to Mr. Gabb, the Tejon Group corresponds very nearly to the Maestricht beds. On palæontological and stratigraphical grounds, it also seems most likely that the coal formation of the Nanaimo, Cowitchin and Comox districts is

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* Some obscure organisms from the Upper Conglomerates (G.) of Hornby Island on the north side of Tribune Bay, which Mr. Richardson thought were fragments of a guard of a Belemnite (G. S. C., Rep. Prog., 1872-73, p. 51), appear to the writer to be pieces of the shelly tube of a *Teredo*, possibly of *T. Suciensis*.

the equivalent in time of the whole of the Upper as distinguished from the Middle Cretaceous, or, in other words, of all those deposits which intervene between the Gault and the Eocene. The four lower divisions of these coal fields are almost certainly Upper Cretaceous, but at present there is no positive evidence to show whether the three upper Divisions are Cretaceous or Tertiary. In California the Martinez Group has never been seen resting directly upon the Chico, nor the Tejon upon the Martinez, but in the Vancouver Upper Cretaceous the stratigraphical sequence of the different Divisions is complete throughout. The local names given by the California geologists to the principal groups of the Upper Cretaceous rocks as developed in that State, lose all their significance when applied to the corresponding deposits on Vancouver and the adjacent islands in the Georgian Strait.

In an appendix to one of Mr. Richardson's reports, Mr. Billings remarks: "According to the researches of Mr. F. B. Meek and Dr. F. V. Hayden in Nebraska, and of Mr. W. M. Gabb in California, the fossils of the Cretaceous formation on the east side of the Rocky Mountains are nearly all specifically distinct from those that occur in rocks of the same age on the west side." "This would seem to establish the existence of a land barrier between the two regions at an early period, and upon this land most probably grew the plants whose remains occur so abundantly in the rocks in question." * In Mr. Meek's monograph of the Cretaceous fossils of the Upper Missouri Country, published in 1876, the only species described as possibly common to the Cretaceous rocks of that region and to those of California and Vancouver Island, is *Ammonites complexus*. The last edition of Prof. Dana's Manual of Geology, dated 1874, contains a map of North America as it appeared in the Cretaceous period, in which the limits of this supposed land barrier are distinctly defined, (except to the north-westwards,) its general direction being represented as nearly coincident with that of the main axis of the Rocky Mountains.

The same facts, however, are capable of an entirely different interpretation, as may be seen by the following quotation from the second volume of the Palæontology of California. "The occurrence of the Cretaceous fauna on the western face of the Sierra Madre," Mr. Gabb says, in a passage which seems to have escaped the notice of Mr. Billings and Prof. Dana, "is a matter of great interest, since it proves conclusively that during that era there must have been a water communication

* Geological Survey of Canada. Report of Progress for 1872-73, p. 71.

between the great Cretaceous sea that covered so much of what is now the central portion of our continent on the one side and the Pacific on the other."..."It is the more remarkable when taken into connection with the fact, that of the more than three hundred species now known in the California Cretaceous, barely one per cent. is found in common on the two sides of the continent."..."From the occurrence in California of *Gryphœa vesicularis* and *Turritella seriatim-granulata*, determined with certainty, and of *Nautilus Texanus* and *Volutilithes Navarroensis*, yet open to doubt, it seems that there was not a continuous land barrier between the two basins."....."It is very probable that future explorations in the yet unknown region between the Saskatchewan and the Pacific, north of our boundaries, will develop a more or less continuous series of Cretaceous deposits showing a similar link on the north."..."The presence of *Ammonites complexus* on Vancouver Island and in California, and the known existence of Cretaceous beds in Eastern Oregon and north-west of the great lakes, render this hypothesis not improbable." *

The results of the most recent explorations in the Vancouver Cretaceous are decidedly in favour of the conclusions arrived at by Mr. Gabb, and the hypothesis of a continuous land barrier between the oceans of the period is scarcely tenable in the present state of our knowledge of the subject. Mr. Richardson's collections, so far as they go, show that the faunæ of the Upper Cretaceous of Vancouver and Texas are even more closely related than are those of the same period in California and Texas, and the missing link between the two Cretaceous oceans to the north-westwards is also, to a certain extent, supplied by these Vancouver fossils. Inclusive of those described in the present report, the exact number of named species of marine invertebrata now known from the Vancouver Upper Cretaceous is one hundred and eight, and eighteen of these are believed to occur also in rocks of the same age on the eastern side of the Rocky Mountains, as shown more in detail in the subjoined lists.

1. Species common to the Upper Cretaceous of Vancouver and Texas.

(A. In Mr. Richardson's collections.)

Fulguraria Navarroensis.	Inoceramus mytilopsis.
Anatina sulcatina.	Terebratula Wacoensis.
Inoceramus undulato-plicatus.	

* Palæontology of California, Vol. II., pp. 257, 258.

(B. In Mr. Etheridge's lists of Nanaimo, Comox, and Valdez Inlet fossils, omitting *Trigonia crenulata*, which Mr. Meek says is his *T. Evansana*.)

Ammonites Texanus.	Inoceramus Texanus.
Cytherea Leonensis.	Inoceramus confertim-annulatus.

2. Fossils found in the Upper Cretaceous of Vancouver, Mississippi, and Alabama.

Gyrodes excavata. (=G. Spillmanii.)	Inoceramus Crippsii, var. proximus
Caryatis plana. (=Aphrodina Tippana.	" " var. Barabini.

3. Species which occur in the Upper Cretaceous of Vancouver and New Jersey.

Heteroceras Conradi.	Inoceramus Crippsii, var. Barabini
Gyrodes excavata. (=Natica infracarinata.)	

4. Fossils believed to be common to the Upper Cretaceous of Vancouver and to the Fort Pierre and Fox Hills Groups of Dakota, Nebraska and Montana.

Serrifusus Dakotensis.	Inoceramus Sagensis, var Nebrascensis.
Mactra Warrenana.	" Crippsii, var. proximus.
Thetiopsis circularis.	" " var. Barabini.
Clisocolus cordatus.	

5. Species from the Upper Cretaceous of Vancouver and the Upper Missouri Country which have been separated on very slight differences, and, in some cases, perhaps, on insufficient grounds.

Vancouver Cretaceous.	*Cretaceous of the U. Missouri Country.*
Ammonites complexus, var. Suciensis, Meek.	Ammonites complexus, Hall & Meek.
Dentalium Nanaimoense, Meek.	Dentalium gracile, Hall & Meek.
Tellina occidentalis, Meek (Sp.) Not Morton.	Tellina equilateralis, Meek & Hayden.
Protocardium scitulum, Meek.	Protocardium subquadratum and rarum of Evans and Shumard.
Cucullæa truncata, Gabb.	Cucullæa Nebrascensis, Owen.
Mytilus pauperculus, Gabb.	Mytilus subarcuatus, Meek & Hayden.
Inoceramus Vancouverensis, Shumard.	Inoceramus altus, Meek.

The theory that the two oceans of the Cretaceous period in North America were isolated by a continuous land barrier is open also to objections of a purely physical character. Dr. F. V. Hayden and other geologists whose opportunities for a practical study of the question have

been exceptionally favourable, maintain that the latest elevation of the Rocky Mountains took place at a period long subsequent to the deposition of the Cretaceous rocks. The exact words made use of by Dr. Hayden in reference to this subject are:—"We believe, therefore, that the elevated ridges which form the nuclei of the mountain ranges began to emerge above the surface of the surrounding country, near the close of the Eocene period." "We think, also, that the evidence is clear that there were periods of subsidence and repose, but the thought which we wish to illustrate is, that there was a slow, long-continued, quiet, upward tendency which began near the close of the Cretaceous epoch, and culminated in the present configuration of the western portion of our continent, near the commencement of our present period."* Along the eastern flanks of the Rocky Mountains, on the "Third Prairie Plateau," in the vicinity of the forty-ninth parallel, strata holding marine fossils of Cretaceous age are known to occur at an elevation of at least 3,000 feet above the present sea level. Even if we suppose that the latest elevation of the Rocky Mountains had been effected prior to the accumulation of these marine sediments, and that the whole continent was subsequently submerged to the depth of 3,000 feet, a water communication between the two oceans would still be possible to the north-westwards, by the valley of the Peace River, as suggested to the writer by Dr. G. M. Dawson.

In the Cretaceous rocks of Europe and Southern India, whose local faunæ have been studied and described by so many palæontologists, it is found that a large number of the species have a very wide geographical distribution. Stoliczka, for instance, says that one fourth of the Cretaceous Cephalopoda, and twelve per cent. of the Pelecypoda (or lamellibranchiata) of Southern India, occur also in deposits of the same age in Europe. Some of the fossils of the Vancouver Cretaceous appear to have an equally extensive geographical range, as may be seen by the following list of species, most of which are believed to be common to the coal-bearing rocks of the Nanaimo and Comox districts and to the chalk formation of Europe, Asia or Africa.

6. Vancouver Upper Cretaceous species which occur in other localities than North America.

Ammonites Gardeni, Baily. —Cape of Good Hope; Baily. S. India and (?) Austria; Stoliczka.

" Velledæ, Mich. —Gault of France and Switzerland; Pictet. Caucasus and S. India; Stoliczka.

* American Journal of Science and Arts, Second Series, Vol. 33, (1862), p. 313.

Ammonites Indra, Forbes. —S. India; Forbes and Stoliczka.
" Jukesii? Sharpe. —Chalk of Londonderry, Ireland; Sharpe.
Hamites cylindraceus? Defr. —U. Chalk, France; Maestricht beds, Denmark; Pictet.
Cerithium Lallierianum, D'Orb.—Gault of France and Switzerland; Pictet.
Gyrodes excavata, Mich. — " " " " "
Corbula minima, D'Orb. —Trichinopoly district of S. India; D'Orbigny and Stoliczka.
Pholadomya Royana, D'Orb. —Senonien or Upper Chalk of the Pyrenean basin; D'Orbigny.
Caryatis plana, Sby. (Sp.) —Upper Greensand of England, Germany and France, Pictet. S. India; Stoliczka.
Nucula pectinata? Sby. —Gault of England and France. The Hornby Island shell is perhaps distinct from the true *N. pectinata*.
Yoldia striatula, Forbes. —S. India; Forbes and Stoliczka.
Inoceramus Crippsii, Mant. —Almost world wide.

Fulguraria Navarroensis of Shumard, which is found in the Upper Cretaceous of Texas, California, Vancouver and the Sucia Islands, is probably only a variety of the *F. elongata*, D'Orbigny, of France and S. India; and *Cucullœa truncata*, Gabb, from Vancouver and California, is barely distinguishable from the European *C. glabra*.

PLATE XI.

Nautilus Suciensis (page 97.)

Figure 1. Side view of the most perfect specimen yet collected.

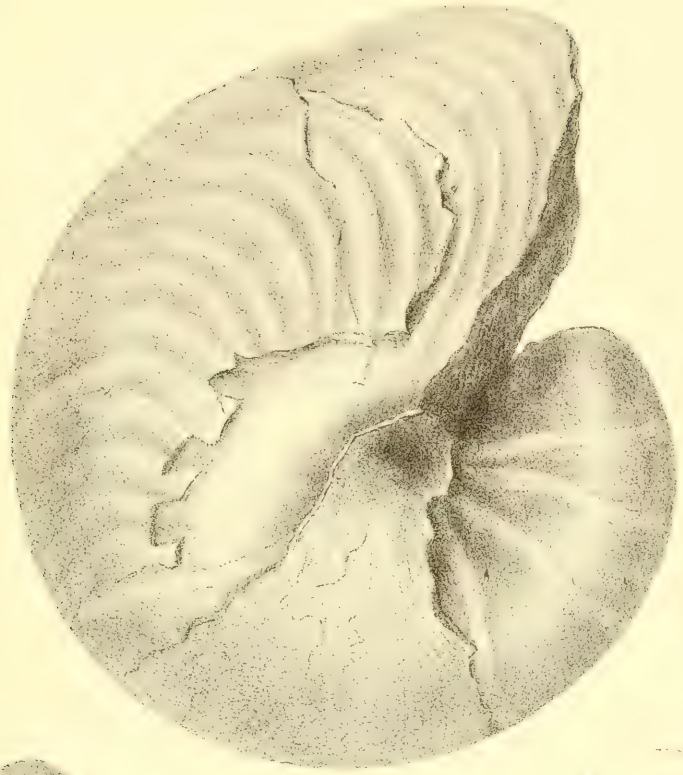
" 1 *a*. Outline of a septum of the same, to show the position of the siphuncle.

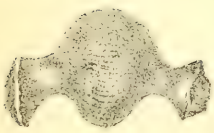
Nautilus Campbelli, Meek (page 99.)

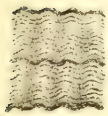
Figure 2. Outline of a detached septum of a small specimen.

" 2 *a*. Another portion of the same specimen, with some of the loose outer chambers removed, showing the cancellate sculpture of the early whorls, and the projecting, shelly cones surrounding the deep, narrow, umbilical perforation.

" 2 *b*. Sculpture of a part of ditto, highly magnified.







A.H.Foord. del. et lith.

Wm.Stuart.Imp!

PLATE XII.

HETEROCERAS CONRADI, Morton, Sp. (page 100.)

Figure 1. The best specimen of this species in the collection.

" 1 *a*. Detached portion of the uncoiled part of the same specimen.

" 2. Fragment of another individual, consisting of one of the early whorls, to show the width of the umbilicus at this stage of growth.

" 2 *a*. Another view of the same.

" 3. Fragment of a nearly adult shell, showing an upward curve of the whorl previous to uncoiling.

Picard del. et lith.

Wm.Stuart Imp!

PLATE XIII.

Ammonites Selwynianus (page 104.)

Figure 1. Front view of a cast of this species, with portions of the test adhering to it, to show the beak-like constrictions on the periphery.

" 1 *a*. Side view of ditto.

Ammonites Indra, Forbes (page 105.)

Figure 2. Side view of a large individual.

" 2 *a*. Portion of the side lobe (?) of the aperture of the same specimen.

Ammonites Jukesii (?), Sharpe (page 111.)

Figure 3. Side view of the only specimen collected.

" 3 *a*. Outline of aperture of ditto.

" 3 *b*. Sculpture of ditto, magnified.

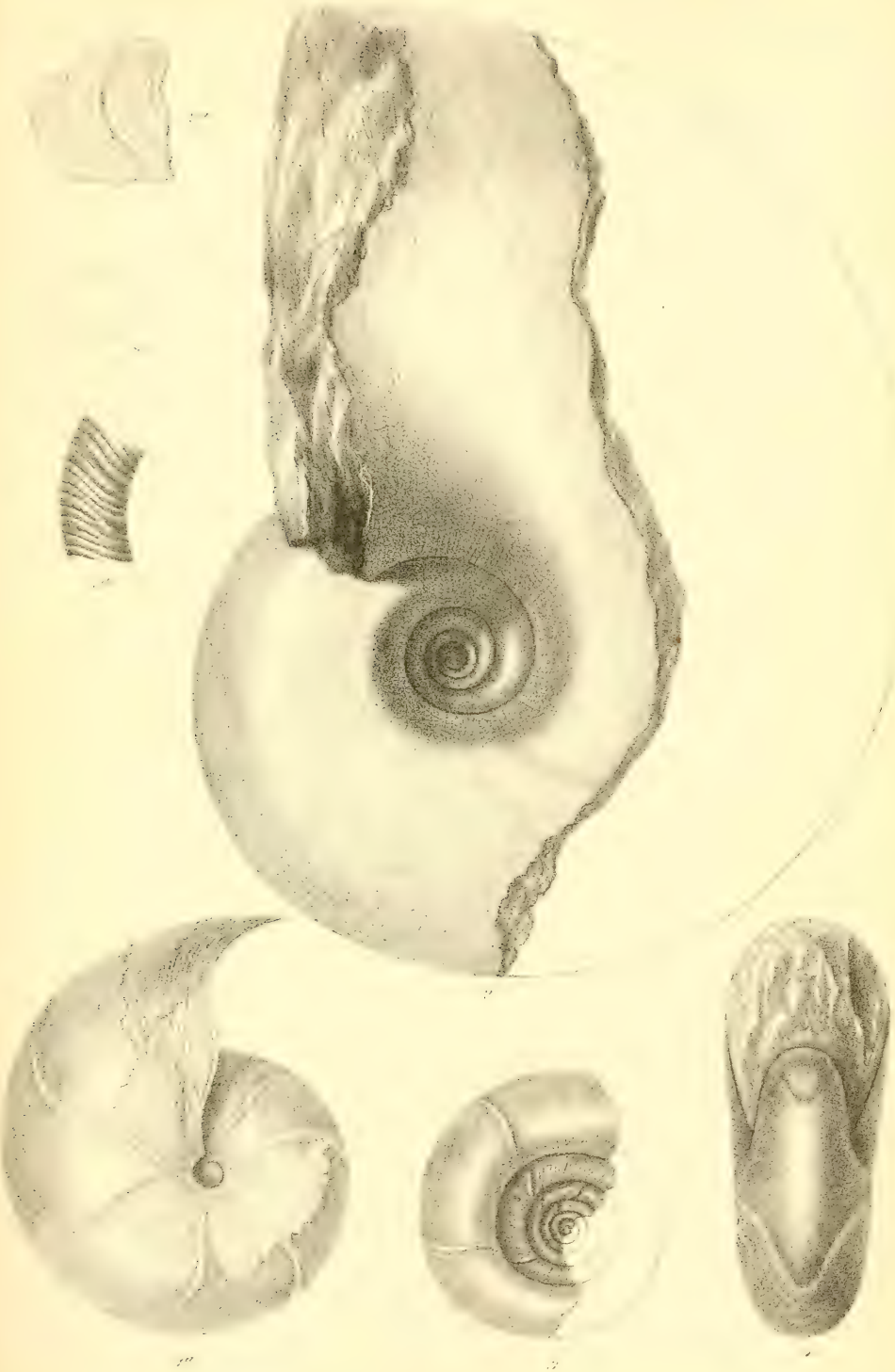


PLATE XIV.

Ammonites Newberryanus, Meek (page 109.)

Figure 1. Side view of a specimen with the test preserved

" 1 *a*. Outline of the aperture of another individual of the same species.

Hamites cylindraceus (?), Defrance (page 113.)

Figure 2. Side view of the only specimen found.

" 2 *a*. Part of a septum of ditto.

Ptychoceras Vancouverense (page 113.)

Figure 3. Side view of the last limb and part of the last but one.

" 3 *a*. Central or nearly central portion of the penultimate limb.

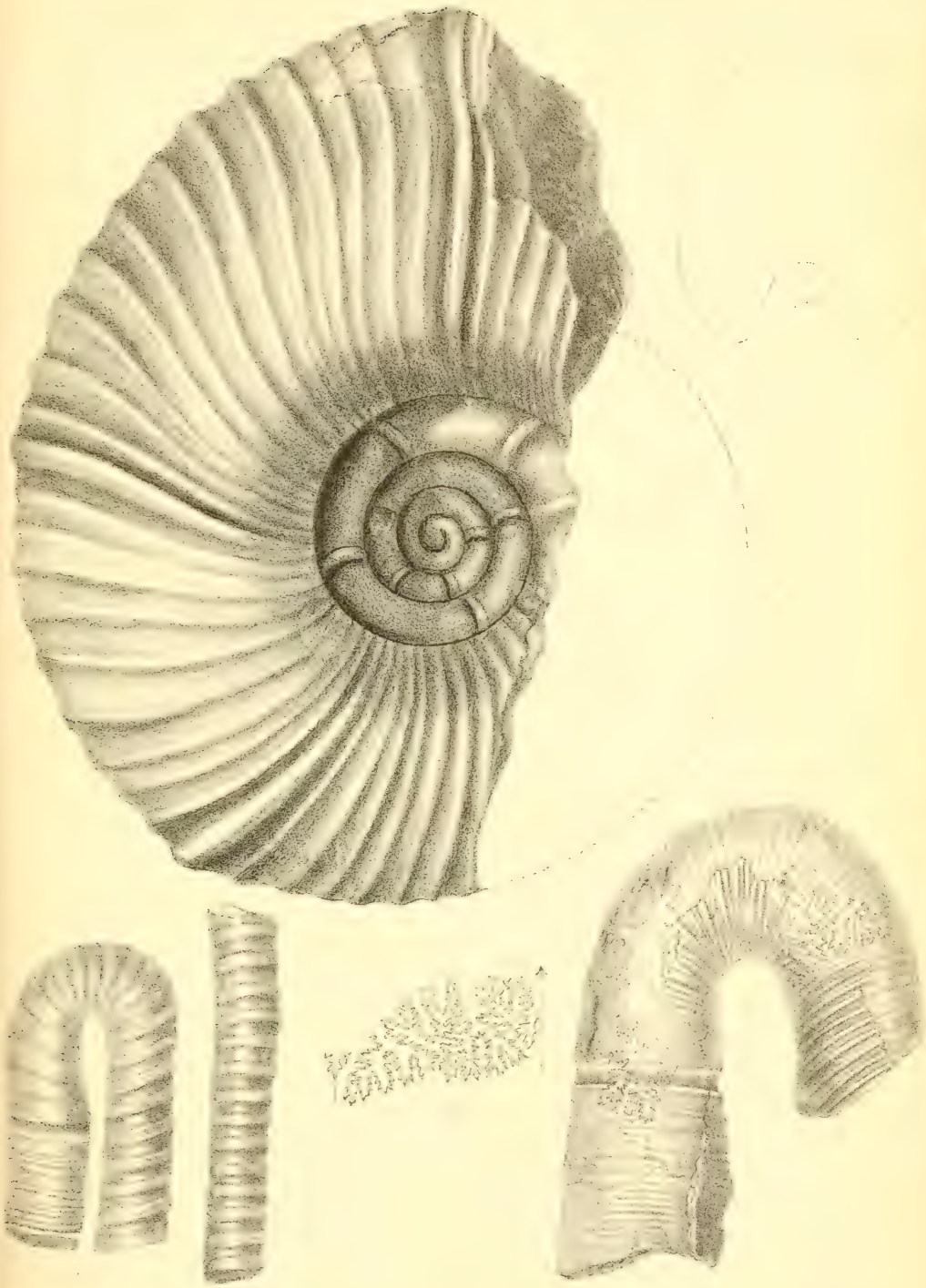


PLATE XV.

Surcula Suciensis (page 115.)

Figure 1. Dorsal view of a specimen, magnified.
" 1 *a*. Actual length.

Surcula raricostata, Gabb (page 116.)

Figure 2. Dorsal view, magnified, of the most perfect individual collected.
" 2 *a*. Actual length.

Fulguraria Navarroensis, Shumard, Sp. (page 117.)

Figure 3. View of an adult shell, to show the characters of the aperture, as far as known.
" 3 *a*. Spire of another example.

Fusus Kingii, Gabb (page 119.)

Figure 4. Ventral aspect.

Serrifusus Dakotensis, var. Vancouverensis (page 119.)

Figure 5. Dorsal view of the only specimen known.

Hindsia nodulosa (page 125.)

Figure 6. Ventral view of a specimen from the Nanaimo River, V. I., to show the teeth and plaits on the columella. The outer lip is imperfect.
" 7. Dorsal view of an adult shell from the Sucia Islands.

Potamides tenuis, Gabb (page 121.)

Figure 8. A perfect, but immature individual, slightly enlarged.
" 8 *a*. Actual length.
" 8 *b*. Portion of the sculpture of the last whorl but one, magnified.

Potamides tenuis, var. Nanaimoensis (page 121.)

Figure 9. Ventral view of one of the best specimens collected.
" 9 *a*. Sculpture of penultimate whorl, magnified.

Cerithium Lallierianum, var. Suciense (page 122.)

Figure 10. Dorsal view of the shell, magnified.
" 10 *a*. Actual length.

Anchura stenoptera, Goldfuss, Sp. (page 123.)

Figure 11. Ventral view of the only specimen in the collection.
" 11 *a*. Dorsal aspect of ditto.

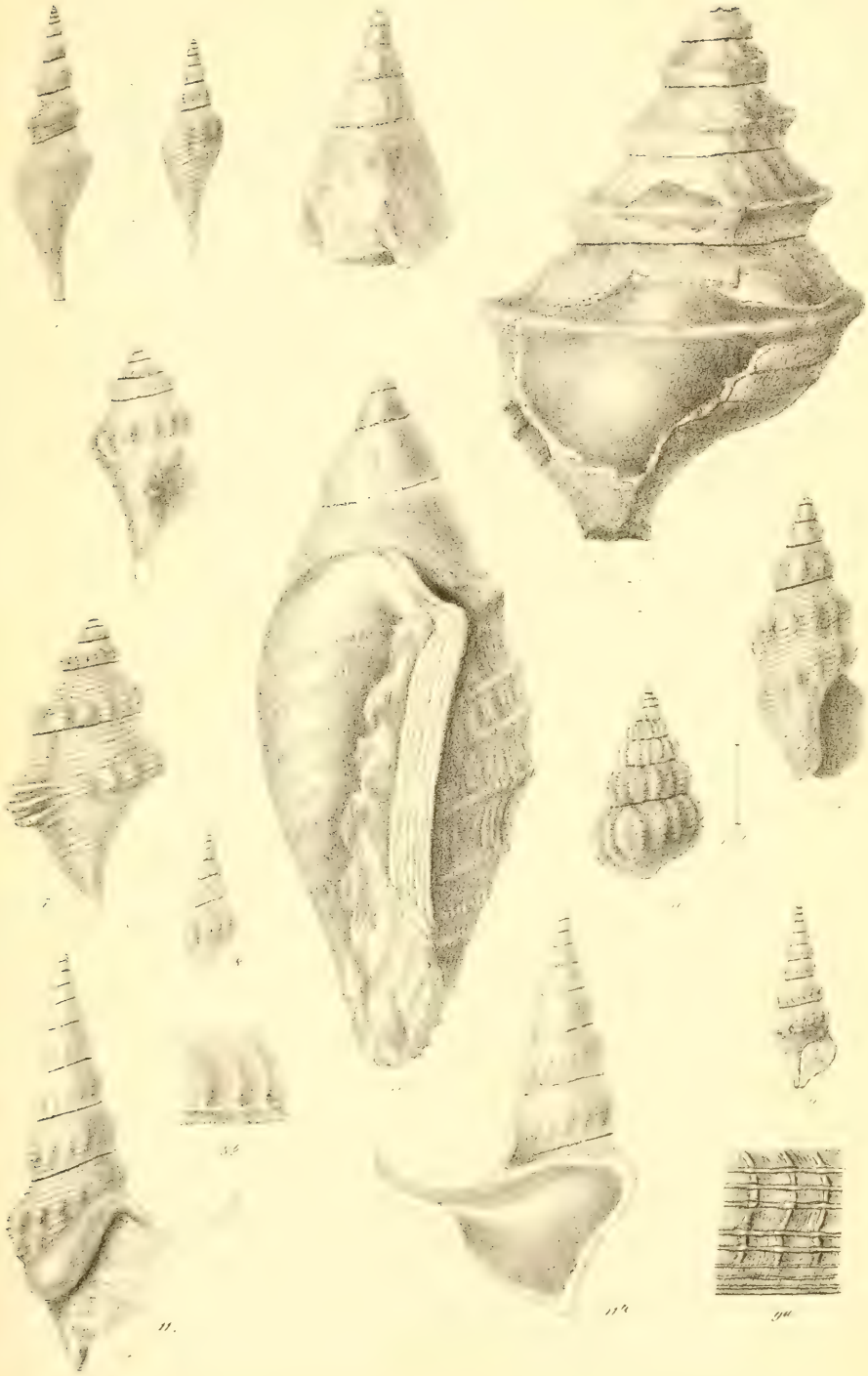


PLATE XVI.

Amauropsis Suciensis (page 123.)

Figure 1. Ventral view of a specimen, to show the shape of the aperture and umbilicus.

Gyrodes excavata, Michelin, Sp. (page 124.)

Figure 2. Dorsal view of a small variety of this species, from the Sucia Islands

" 2 *a*. Ventral aspect of ditto.

Cirsotrema tenuisculptum (page 127.)

Figure 3. Dorsal view of the type of the species, slightly enlarged.

" 3 *a*. Ventral aspect of the same.

" 3 *b*. Actual length.

" 3 *c*. Sculpture of body whorl, magnified.

Stomatia Suciensis (page 128.)

Figure 4. Dorsal view of a large but imperfect specimen, with the defective part restored in outline.

Stomatia Suciensis, var. carinifera (page 128.)

Figure 5. Dorsal view of a specimen with four concentric ridges on the body whorl.

Acmea, Sp. undt. (page 130.)

Figure 6. Cast of the interior, magnified, showing the muscular impressions.

" 6 *a*. Actual length.

Cinuliopsis typica (page 131.)

Figure 7. Ventral view of the type specimen, showing the mouth.

" 7 *a* Dorsal aspect of the same.

" 7 *b*. Sculpture of body whorl, magnified.

Haminea Hornii, Gabb, Sp. (page 132.)

Figure 8. Dorsal view of a small but very perfect individual, magnified.

" 8 *a*. Actual length.

" 8 *b*. Portion of the surface markings, highly magnified.

Dentalium Nanaimoense, Meek (page 133.)

Figure 9. A large but imperfect individual, partly restored in outline

" 9 *a*. Sculpture of ditto, magnified.

" 9 *b*. A smaller but more perfect specimen.

Entalis Cooperi, Gabb, Sp. (page 134.)

Figure 10. A large and nearly perfect example.

" 10 *a*. Sculpture of the same, magnified.

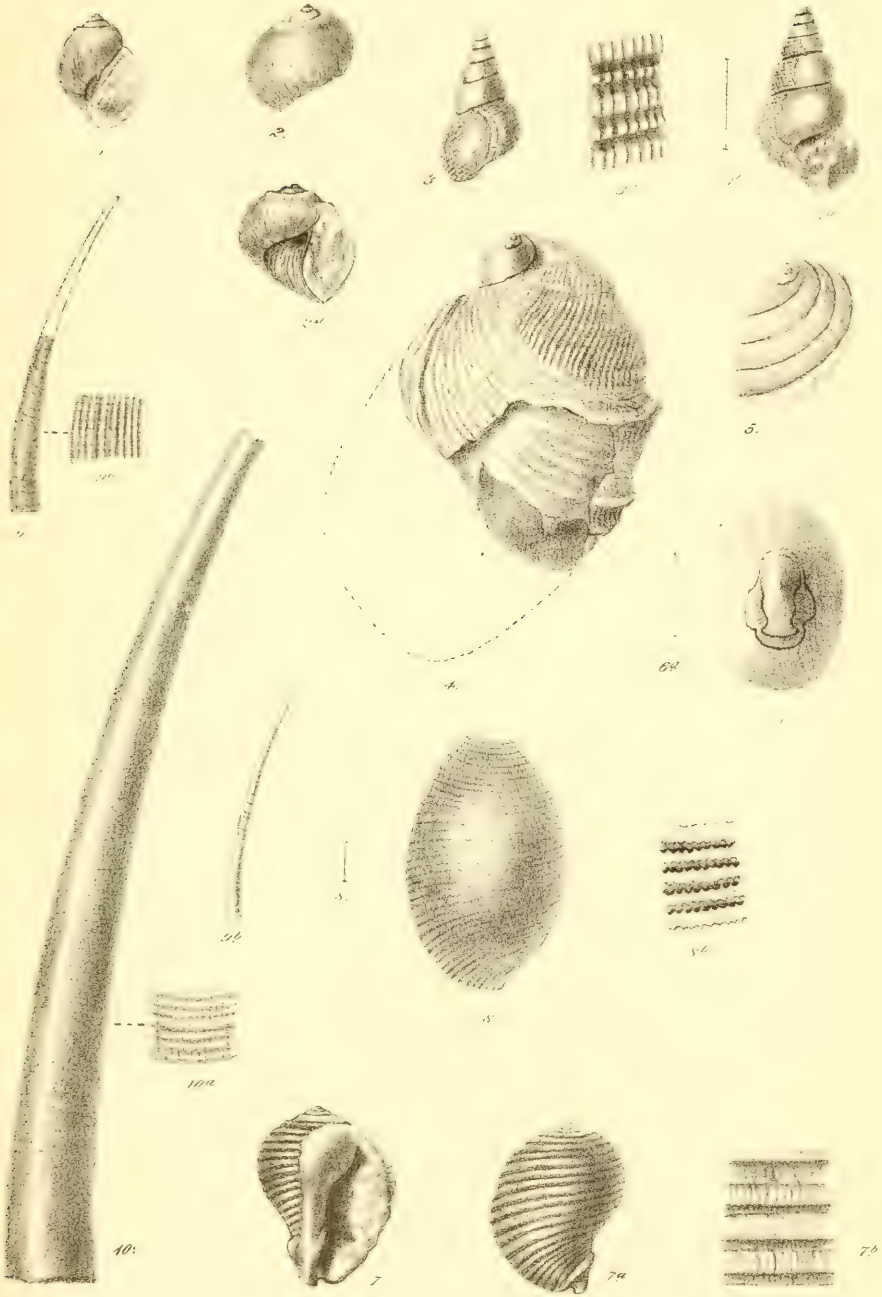


PLATE XVII.

Teredo Suciensis (page 135.)

Figure 1. Right valve.
" 1 *a*. Portion of the shelly tube of another specimen.

Martesia clausa, Gabb (page 137.)

Figure 2. Left valve of a perfect specimen.
" 2 *a*. Dorsal aspect of the same, to show the umbonal accessory plate.
" 2 *b*. Outline of ventral side of the same, showing the shape of the foot opening.

Corbula Traskii (?), Gabb (page 138.)

Figure 3. A right valve supposed to belong to this species.

Corbula minima, D'Orbigny (page 138.)

Figure 4. Right valve.
" 4 *a*. Left ditto.

Anatina sulcatina, Shumard (page 139.)

Figure 5. Right valve of a large and nearly perfect individual.
" 5 *a*. Left valve of another specimen.

Periploma suborbiculatum (page 138.)

Figure 6. Right valve of the type of this species

Thracia subtruncata, Meek (page 140.)

Figure 7. A left valve with the posterior extremity imperfect.

Cymbophora Ashburnerii, Gabb (page 141.)

Figure 8. Left valve of a specimen of the ribbed variety of this species.

Mactra (Cymbophora?) Warrenana, Meek & Hayden (page 142.)

Figure 9. Left valve of an average example. The concentric striations of the surface are far too coarse, and, as the figure does not give a very good idea of the true sculpture of the shell, two additional illustrations of the species are given on plate 19.

Tellina (Œne) Sp. undt. (page 143.)

Figure 10. Left valve of a small specimen.

Tellina (Peronæa) occidentalis, Meek, Sp. (page 144.)

Figure 11. Left valve, with the test preserved.
" 11 *a*. Cast of a left valve, showing the muscular impressions and the deep pallial sinus.

Linearia Suciensis (page 146.)

Figure 12. Right valve of the only specimen collected.

Cytherea (Callista) laciniata, Stoliczka (page 148.)

Figure 13. Left valve.
" 13 *a*. Outline of a cast of another left valve, showing the muscular impressions and pallial sinus.

Cytherea (Caryatis) plana, Sowerby, Sp. (page 149.)

Figure 14. Right valve of a medium sized example.
" 14 *a*. Right valve of a smaller specimen.
" 14 *b*. Interior of the last, showing the hinge teeth.

Cyprimeria lens, Gabb, Sp. (page 152.)

Figure 15. Left valve of a variety of this species.
" 15 *a*. Portion of interior of another left valve, showing the hinge teeth.

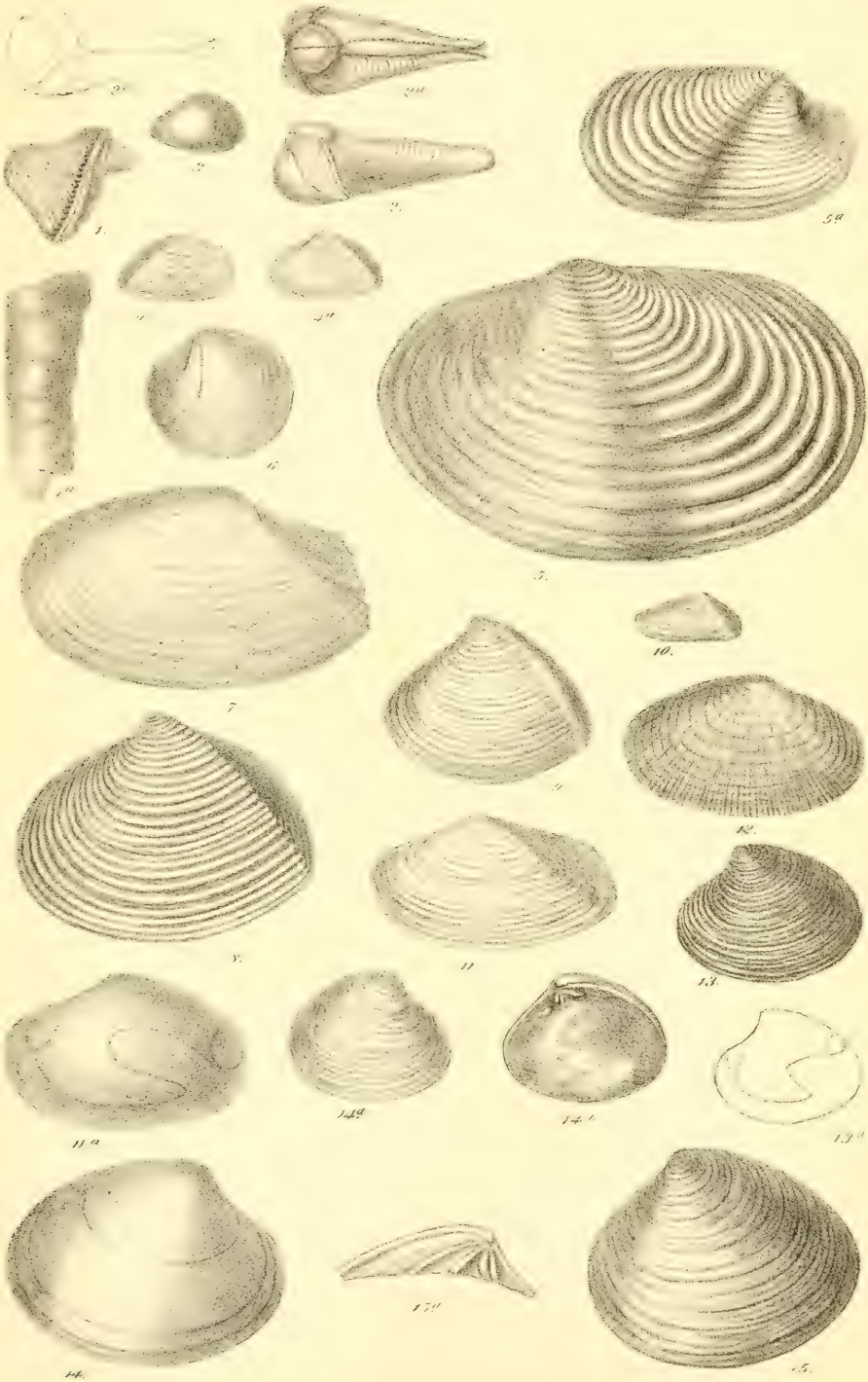


PLATE XVIII.

Veniella crassa (page 153.)

Figure 1. Left valve of the type specimen, with the posterior extremity restored in outline.

Lævicardium Suciense (page 154.)

Figure 2. Right valve of the largest specimen collected.

Clisocolus cordatus, Meek & Hayden, Sp. (page 157.)

Figure 3. Left valve of a nearly perfect adult example.
" 3 *a*. Portion of the interior of a left valve, showing the hinge plate.
" 3 *b*. View of the corresponding portion of the right valve.

Opis Vancouverensis (page 158.)

Figure 4. Exterior of a right valve of the only specimen known.
" 4 *a*. Interior of the same, showing the hinge teeth.

Astarte Conradiana, Gabb (page 160.)

Figure 5. View of a perfect example, with both valves.
" 5 *a*. Interior of a detached left valve, showing the hinge teeth and part of the crenulated basal margin.

Astarte Conradiana, var. Tuscana (page 160.)

Figure 6. Side view of a perfect specimen, showing only the left valve, for comparison with figure 5.

Trigonia Tryoniana, Gabb (page 161.)

Figure 7. A left valve.

Nucula pectinata (?), Sowerby, var. (page 161.)

Figure 8. Distorted left valve of a shell supposed to be a variety of this species.

Yoldia striatula, Forbes, Sp. (page 162.)

Figure 9. Left valve, enlarged, to show the surface markings more clearly.

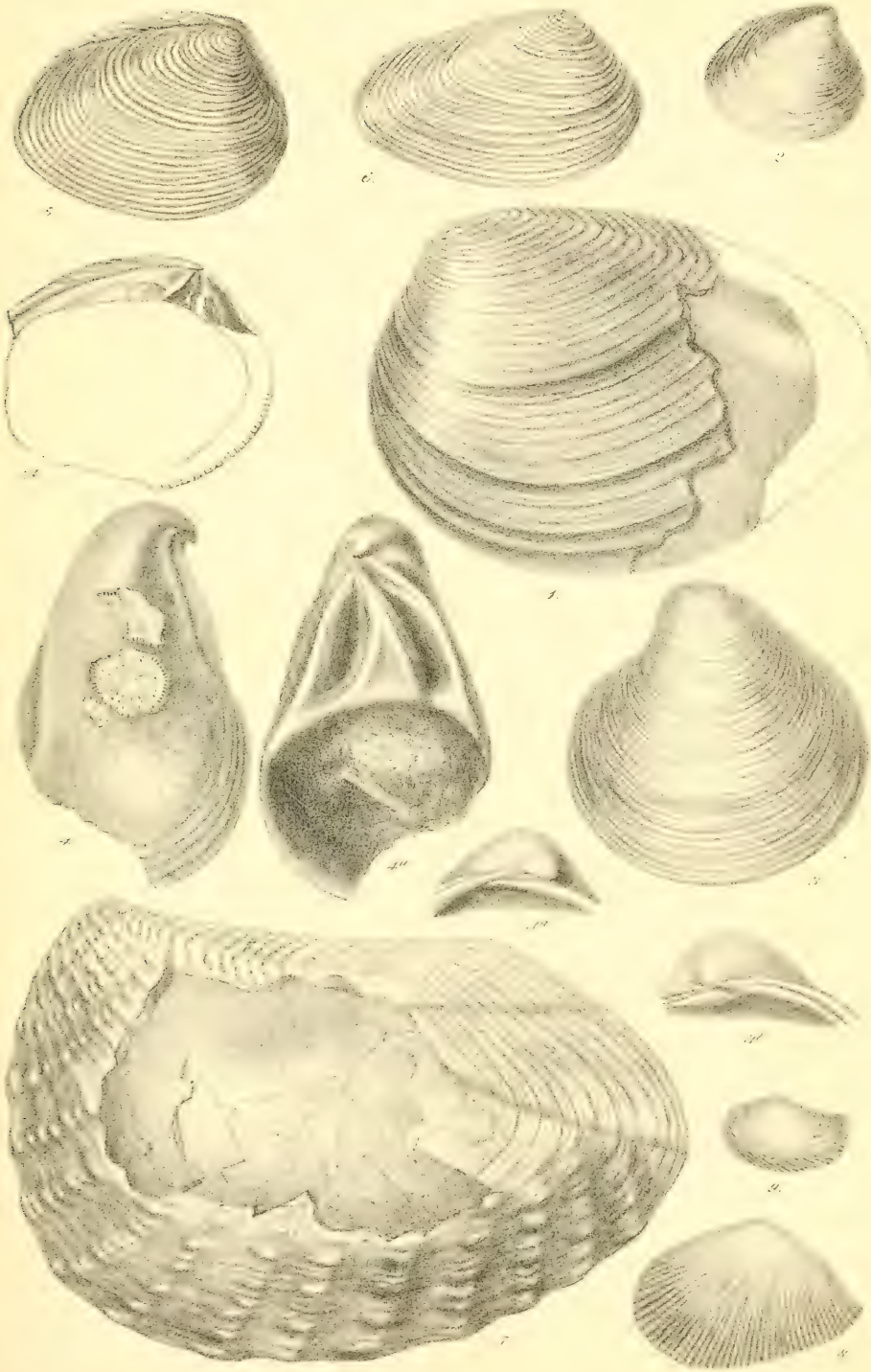


PLATE XIX.

Nemodon Vancouverensis, Meek, Sp. (page 163.)

Figure 1. Left valve of a fine adult specimen.

" 1 *a*. Interior of a right valve, showing the hinge dentition.

Cucullæa (Idonearca) truncata, Gabb (page 165.)

Figure 2. Specimen in which the posterior side is unusually short and truncated almost vertically at its extremity.

" 2 *a*. Another example whose posterior side is produced and truncated very obliquely at its margin. This is the form of the species which is most like Meek's figure of C. Nebrascensis, Owen.

Mactra (Cymbophora ?) Warrenana, Meek & Hayden (page 142.)

Figure 3. Left valve, side view.

" 3 *a*. Right valve of another specimen.

Cytherea (Callista) laciniata, Stoliczka (page 148.)

Figure 4. Left valve.

" 4 *a*. Sculpture of the same, magnified.

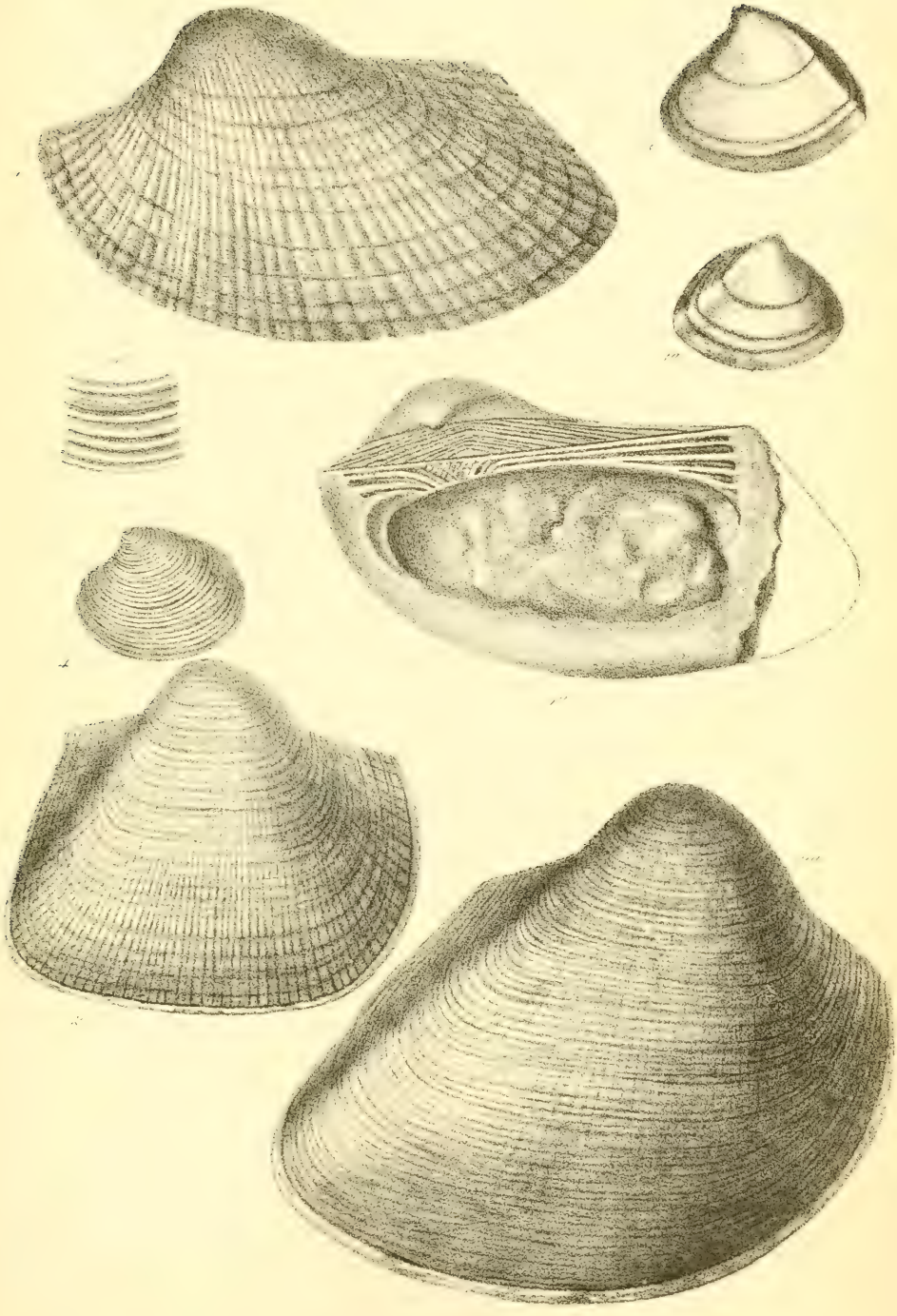


PLATE XX.

Pinna calamitoides, Shumard (page 167.)

Figures 1, 1 *a* and 1 *b*. Three detached fragments of this species.

Inoceramus undulato-plicatus, Rœmer (page 168.)

Figure 2. Right valve of a young but perfect specimen.

" 2 *a*. Left valve of another immature shell.

Inoceramus mytilopsis, Conrad (page 169.)

Figure 3. Left valve of an aberrant form of this species.

Inoceramus Vancouverensis, Shumard (page 170.)

Figure 4. Left valve of a specimen whose length and height are nearly equal.

" 4 *a*. The most common form of the species, in which the height considerably exceeds the length.

" 4 *b*. Umbonal region of a specimen whose beaks are abnormally developed.

Anomia Vancouverensis, Gabb (page 175.)

Figures 5 and 5 *a*. Two upper valves, which retain the markings of some ribbed shell on which they have grown.

" 5 *b*. An upper valve, showing the true surface markings.

" 5 *c*. Side view of the same, to shew the amount of convexity.

" 5 *d*. Minute radiating striæ of the test, highly magnified.

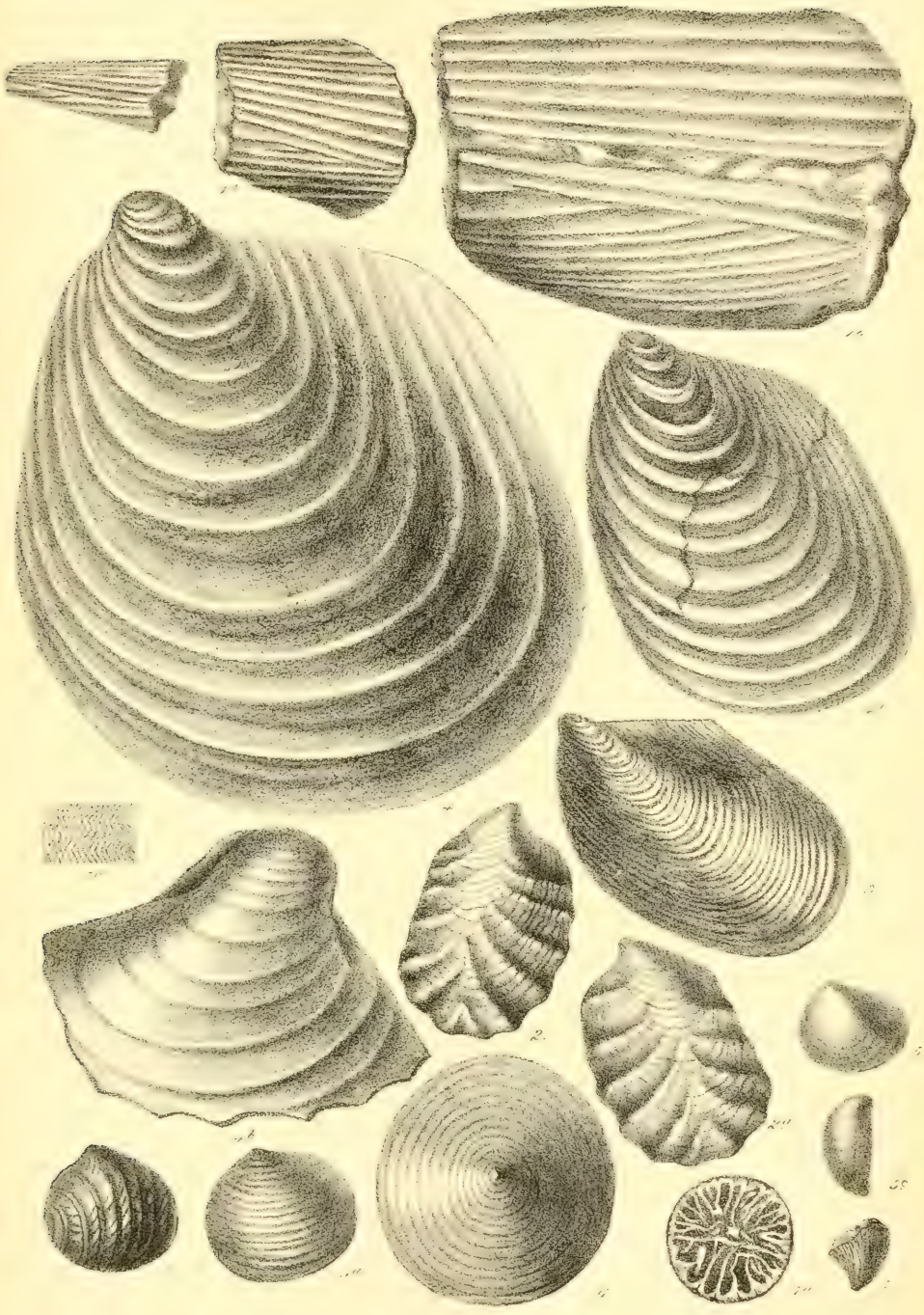
Discina Vancouverensis (page 177.)

Figure 6. Upper valve of the type specimen.

Smilotrochus Vancouverensis (page 178.)

Figure 7. Side view of the only specimen.

" 7 *a*. Transverse section of the same, at or near the summit.



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GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.

ALFRED R. C. SELWYN, L.L.D., F.R.S., F.G.S., DIRECTOR.

MESOZOIC FOSSILS.

VOLUME I.

PART III.—On the Fossils of the Coal-Bearing Deposits of the Queen Charlotte Islands collected by Dr. G. M. Dawson in 1878,

—BY—

J. F. WHITEAVES, F.G.S., F.R.S.C., ETC.,

PALÆONTOLOGIST AND ZOOLOGIST, G. & N. H. S. C.

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The publication of the present report has been much delayed, first, by the removal of the Museum and Offices of the Survey from Montreal to Ottawa in 1881, next by the death of Mr. J. H. Balbirnie, who was to have lithographed the plates, in the spring of 1883, and lastly, by the resignation of the artist, Mr. A. H. Foord, which practically took place on the first of June, 1883.

Most of the text has been written and four of the plates have been printed off more than twelve months ago.

Plate 33 will be issued with Part 4, which is now in course of preparation, and which will complete the volume.

ALFRED R. C. SELWYN.

Geological and Natural History Survey Office,
Ottawa, March 25th, 1884.

GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.

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MESOZOIC FOSSILS.

BY J. F. WHITEAVES.

VOLUME I.

III. On the Fossils of the Coal-Bearing deposits of the Queen Charlotte Islands collected by Dr. G. M. Dawson in 1878.

Introductory Remarks.

In 1872 Mr. James Richardson visited the Queen Charlotte Islands on behalf of the Geological Survey of Canada and spent a few days in the examination of the Coal mines at Cowgitz and of the geological structure of Skidegate Inlet. A description of his observations on this occasion will be found on pages 56-65 of the Report of Progress of the Survey for 1872-73. As pointed out in the first part of the present volume, in which the species were described and figured, the small series of fossils collected by Mr. Richardson from these coal-bearing deposits was scarcely sufficient to establish the exact geological horizon of the latter.

Six years later a much more extended geological and geographical exploration of the Queen Charlotte Islands was made by Dr. G. M. Dawson, who has since published a detailed account of the results of his explorations and of the conclusions arrived at therefrom in the "Report of Progress" of the Canadian Survey for 1878-79, to which the reader is referred for the fullest and latest information on the subject.

The following tabular view of the formations which have been recognized in these islands, in descending order, is condensed from that given on page 48 B of the volume just cited, with some slight additions and alterations suggested by Dr. Dawson.

24-3-'84.

FORMATIONS RECOGNIZED IN THE QUEEN CHARLOTTE ISLANDS.

Post Pliocene.

Unconformity, with evidence of some flexure and disturbance of Tertiary beds.

Tertiary, probably Miocene.

Complete unconformity, with evidence of great disturbance. Chief period of mountain making.

Cretaceous.	A. Upper Shales and Sandstones	1,500	feet.
	B. Coarse Conglomerates	2,000	"
	C. Lower Shales and Sandstones, with coal	5,000	"
	D. Agglomerates	3,500	"
	E. Lower Sandstones	1,000 (?)	"
	Total	13,000	feet.

Unconformity, but without evidence of great disturbance.

Triassic, with probably also some Carboniferous rocks.

Preliminary lists of the Post Pliocene, Tertiary, Triassic and Palæozoic fossils, prepared by the writer, are given in Dr. Dawson's report. By far the largest number of fossils collected by Dr. Dawson, however, consisting of upwards of one thousand specimens, are from the Newer Mesozoic strata of Skidegate and Cumshewa Inlets, which can now be shown to be of Cretaceous rather than of Jurassic age. An illustrated description of the various species obtained from these Cretaceous rocks will form the subject of the present memoir. As shewn on the geologically coloured map of the islands which accompanies Dr. Dawson's report, the Cretaceous rocks from which the fossils now to be described were obtained occur in the form of a belt averaging nearly fifteen miles in breadth, which crosses the centre of the group somewhat obliquely and which extends from Cumshewa and Skidegate Inlets, on the east side, to the west coast.

The fossils from the purely local divisions A to E, inclusive, of the Cretaceous rocks as given in the preceding tabular view of formations and in Dr. Dawson's report will be described separately in the following pages, in descending order, the localities for each species and the exact horizons from which they were collected being of course given on the authority of the collector.

DESCRIPTION OF SPECIES.

1.—From the "Upper Shales and Sandstones," or Sub-division A. of Dr. G. M. Dawson's Report.

Inoceramus problematicus, Schlotheim.

Ostracites labiatus, Schlotheim.	—1813.	Bronn's Jahrbuch, Vol. VII, p. 93. Teste Stoliczka.
Mytilites problematicus, Schlotheim	—1820.	Petrefactenkunde, Vol. I., p. 302.
Mytiloides labiatus, Bronginart.	—1822.	Cuvier's Ossemens Fossiles, pl. 3, fig. 4, in Geol. des Env. de Paris.
Inoceramus mytiloides, Mantell.	—1822.	Geology of Sussex, p. 215, pl. 27, fig. 2, and pl. 28, fig. 2.
" " Sowerby.	—1823.	Mineral Conchology, Vol. V., p. 62, pl. 442.
" " Goldfuss.	—1836.	Petrefactæ Germanicæ, Vol. II. p. 188, pl. 113, fig. 4.
Inoceramus problematicus, d'Orbigny.	—1843.	Paléontologie Française, Terr. Crét. Vol. III. p. 510, pl. 406.
" " Meek & Hayden.	—1857.	Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. IX. p. 119.
" " Meek.	—1876.	Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country, p. 62, pl. 9, figs. 3*a–b*.
Inoceramus pseudomytiloides, Schiel,	—1855.	Pacific Railroad Reports, Vol. II. p. 108, pl. 3, fig. 8.

Skidegate Inlet, Shore between Slate Chuck Brook and Lina Island: five specimens. According to Dr. G. M. Dawson the typical locality of Subdivision A.

Point North of Lina Island, in Bear Skin Bay—three specimens. Dr. G. M. Dawson says: "This place is coloured as C on the map, but the beds are disturbed, and they may not actually belong to this subdivision. Their lithological character certainly resembles that of the Upper Shales, but this does not go for much."

The specimens collected by Mr. Richardson from the Upper Shales of Graham Island near Cowgitz, and mentioned on page 79 of this volume as being possibly referable to *I. concentricus*, are now known to belong to the present species.

In Great Britain and Europe *I. problematicus* is stated to occur in the Lower or Grey Chalk, the Turonien of d'Orbigny, and in the Upper

Green Sand or Cenomanien. In the United States it is said to be most frequently met with in the Niobrara Division, but it is also sometimes found in the Fort Benton Group.

2.—From the Coarse Conglomerates, or Subdivision B. of Dr. G. M. Dawson's Report.

The only fossil yet obtained from these conglomerates is a worn fragment of the guard of a Belemnite which it is impossible to determine specifically.

3.—From the Lower Shales and Sandstones, or Subdivision C. of Dr. G. M. Dawson's Report.

CEPHALOPODA.

Belemnites densus, Meek and Hayden.

Plate 22, fig. 1.

Belemnites densus, Meek & Hayden.	—1858. Proceedings of the Academy of Natural Sciences of Philadelphia, p. 58, and do. for 1860, p. 418.
" "	—1865. Palæontology of the Upper Missouri, p. 126, pl. 4, figs. 10 *a*, *b*, *c*, and Pl. 5, figs. 1 *d*, *e*, *f*, cœt. exclus.
" "	Meek.—1876. Simpson's Report on Explorations across the Great Basin of Utah, Rep. on the Palæontological colections, p. 358, pl. 3, figs. 4 *a*, *b*.
Belemnites, Sp. Undt.	—This volume, p. 11, woodcut fig. 1, and pl. 1, figs. 1, 1*a*, 1*b* and 1*c*.

Guard comparatively short and thick, increasing rapidly in breadth from the point to a distance of about one-half or three-quarters of an

inch and then becoming subcylindrical and of nearly uniform thickness. Apices of guard and phragmocone eccentric and placed nearest to the siphonal side. Alveolar cavity occuping much more than one-half of the entire guard: outline of transverse section at the thickest end nearly circular, but a little flattened at the sides.

Length of the only specimen collected, sixty millimetres; maximum breadth of the same, at the larger end and from the siphonal to the antisiphonal side, twenty-one and a-half millimetres.

"Coal locality, South side of Skidegate Channel, from base of Subdivision C." Dr. G. M. Dawson. One distorted, imperfect, and badly preserved example.

In the Queen Charlotte Islands, as in the Black Hills of Dakota, the few and imperfect guards of Belemnites which have yet been collected appear to be readily separable into two sets, viz., into those which are short and comparatively thick, and into those which are long and comparatively slender. The Skidegate representatives of the former set seem to correspond fairly well with the typical form of *B. densus* from Dakota, while specimens of the latter set from the same locality agree perfectly with slender individuals from the Black Hills which have been described as a variety of that species, but which Mr. Meek thinks may be probably distinct and to which therefore it has here been thought convenient to apply a provisional name.

The apices of the specimen described above and of the one collected by Mr. Richardson in 1872 are no doubt rather more abruptly pointed than are those of some of the types of *B. densus* from Dakota as here restricted, but no other appreciable difference can be detected between them. Moreover, the Utah specimen of *B. densus* figured by Meek is quite as abruptly pointed as the one from Skidegate Inlet represented on Plate 22. The guard of the specimen collected by Mr. Richardson and described on pages 11 and 12 of the present volume has a faint apical groove on the siphonal and presumably ventral side, but the one obtained by Dr. Dawson, which is larger as well as proportionally shorter and thicker, has no apical groove.

Belemnites Skidegatensis. (Nom. Prov.)

Plate 22, figs. 2, 2 *a*, 2 *b* and 2 *c*.

Belemnites densus, Meek & Hayden.—"Slender variety." Palæontology of the Upper Missouri, p. 5, figs. 1*a*, *b*, *c*, only.

Guard rather long and slender, increasing very gradually in thickness from the point upwards: outline of transverse section at the

largest end nearly circular, but compressed slightly and somewhat obliquely at the sides. Alveolar cavity occupying about one half of the entire length in average specimens: chambers in the phragmocone very numerous and approximated: apices of both guard and phragmocone eccentric and placed nearest to the siphonal side. Apex of guard in some specimens with, and in others without, a narrow faint groove on the siphonal side.

Length of the most perfect specimen collected: seven and a half centimetres; diameter of the same, from the siphonal to the antisiphonal side, at the largest end, fourteen millimetres.

Skidegate Inlet, East side of Alliford Bay, three specimens; also South side of same bay, four specimens; all from rocks which Dr. Dawson regards as near the base of Subdivision C.

On page 127 of the "Palæontology of the Upper Missouri," after describing the typical form of *Belemnites densus*, and discussing its probable affinities, the following remarks are added by Mr. Meek:— "Along with these large specimens" (of *B. densus*) "we find several smaller ones, having a proportionally more slender form and a more nearly central axial line. Some of these also have a quite distinct, though narrow, ventral groove, while their transverse section varies from subcircular to oblong-oval. These, we suspect, belong to a distinct species, but, without better and more extensive collections for comparison, we have not been quite able to satisfy ourselves that they may not be younger individuals of the more robust form. These two varieties appear to bear exactly the same relations that the large and small specimens of *B. Panderianus*, figured by d'Orbigny, do to each other." In the "explanations of plate V." of the same volume, Mr. Meek goes a little farther than this, and adds a statement to the effect that the slender Belemnite from Dakota, represented by figures 1*h* and 1*i* of that plate, which has "a distinct ventral furrow," may possibly belong to a different species to those from the same locality, which are equally slender but which have no ventral furrow.

The seven specimens collected by Dr. G. M. Dawson at Skidegate Inlet, and to which the name *B. Skidegatensis* has been provisionally applied, have no distinct median ventral furrow, but only a faint apical groove on the siphonal and therefore possibly ventral side.

It is worthy of note that the short and thick form of the *Belemnites Panderianus* of D'Orbigny, to which Eichwald has given the name *B. curtus*, and which Meek thought that *B. densus* was intimately related to, is regarded by Eichwald in the "Lethæa Rossica"* as a Neocomian rather than a Jurassic species.

* Volume 2, page 100.

In addition to the guards already described, three large and detached phragmocones of Belemnites, or portions of phragmocones, were collected by Dr. G. M. Dawson, on the south side of Alliford Bay, and one on the north shore of Cumshewa Inlet. The most perfect of these is about three inches in length by one inch and three quarters in diameter at the larger end, and one inch at the smaller. These specimens may have formed part of very large individuals of *B. densus*, but they do not possess any characters by which they can be identified.

Nautilus Suciensis, Whiteaves.

Plate 21.

Nautilus, Sp. Undt.

Nautilus Suciensis, Whiteaves. —This volume, page 14. Ib., page 97, plate 11, figs. 1 and 1a.

Six large ribbed Nautili which are specifically identical with the fine specimen of a *Nautilus* obtained by Mr. Richardson in 1872 and described on pages 14 and 15 of the present volume, were collected by Dr. G. M. Dawson at two localities in Skidegate Inlet. On examination and comparison, these specimens appear to represent only a rather finely ribbed and stratigraphical as well as local variety of the *N. Suciensis* from the Sucia Islands, a species which was based on one nearly entire but comparatively small specimen with the nacreous layer of the test only preserved, and a fragment of the cast of a much larger individual. The following is an amended description of the Queen Charlotte Island variety of the species:—

Shell large (the maximum diameter of the largest specimen being fully seven inches) inflated, subglobose but always depressed in the centre of the umbilical region, periphery broadly rounded, sometimes flattened or even slightly concave in the middle. Inner whorls completely covered by the last volution, umbilicus closed or nearly so when the test is preserved, its place being occupied by a narrow but somewhat deep depression or pit,—small and funnel-shaped in the cast. Aperture subcircular, (or in some specimens almost subquadrate) and rather deeply emarginated by the encroachment of the preceding volution. Surface of the outer whorl marked by numerous (about sixty) flattened, radiating ribs, which curve boldly forwards over the outer half of the sides and backwards on the periphery, upon which latter each rib forms a moderately deep but scarcely angular sinus. Test thick.

Septa approximated, from twenty to twenty-two in the whorl nearest to the aperture: margins of the septa, as seen on the cast, slightly flexuous, gently convex next the umbilical perforation, concave on and towards the outer half of the sides, and straight or slightly convex on the periphery. Siphuncle nearly central, but placed a little on the inner side of the centre of each septum.

Exact localities: Skidegate Inlet one mile and three-quarters southwest of Welcome Point, and Bay east of Alliford Bay.

Genus Spiroceras, Meek.

Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country. Washington, 1876. Pages 485 and 486.

Shell somewhat resembling that of *Helicoceras*, as typified by *H. annulatum*, d'Orbigny, but differing therefrom in "its more closely coiled volutions, more produced spire and particularly in consequence of having the costæ that cross its siphonal side, with nodes placed between them, so as to form three longitudinal rows along this outer surface." "It is also much larger and more robust than d'Orbigny's types of *Helicoceras*." Type of the genus, *Turrilites Robertianus*, d'Orbigny.*

Spiroceras Carlottense. (N. Sp.)

Shell apparently either sinistral or dextral, large, the largest fragment known, which consists of nearly the whole of one volution, being at least six inches in diameter. Cavity in the centre of the whorls, which corresponds to the umbilical perforation, equal to about one-third of the entire breadth of the base: outline of aperture nearly circular. Outer surface of the later whorls marked by transverse rows of broad, low, rounded tubercles or nodes, which alternate with two simple ribs. In each of the transverse rows there are four tubercles or nodes, one above and three below the siphuncle. The simple ribs which alternate in pairs with each row of nodes are transverse also, but they curve back slightly in passing over the siphuncle. In a fragment which probably belongs to this species and which consists of portions of two of the earlier whorls, the rows of tubercles are represented by rows of conical spines, which latter are about two lines in height. Septum unknown.

North shore of Cumshewa Inlet: two large septate fragments, each consisting of nearly an entire whorl, but both so badly water worn

* Paléontologie Française. Terrains Crétacés, vol. 1, page 585. Atlas, plate 142.

that most of the finer details of their sculpture and septation are obliterated, and which therefore are not figured.

The earlier whorls of what appears to have been a young individual of the same species are partly shewn in a much smaller specimen from the same locality, which has much the appearance of a small *Turrilites*, except that its volutions are not in contact. The specimen consists of a nodule of argillaceous limestone, so broken as to expose one entire but exfoliated whorl, with the impression of the lower half (or more) of the one which preceded it. The larger of these two whorls shews no remains of either tubercles or spines, but the mould of the basal portion of the upper and smaller whorls exhibits the impressions of four transverse rows of spines, with three spines in each row. As all the remains of spines that happen to be visible in this specimen are placed apparently below the siphuncle, and as the larger examples shew three tubercles below the siphuncle and one above it, in each transverse row, it seems probable that in the earlier whorls there was originally one spine in each transverse row, above the siphuncle, as well as three spines in each row below it.

The specimens for which the above name is proposed are similar in many respects to the European type of the genus, but on the whole seem to be sufficiently distinct to warrant their separation. On the later volutions of the present species there appear to be invariably four tubercles or nodes in each transverse row and its earlier whorls were probably spinose, whereas in the later whorls of the European *Turrilites Robertianus* there are only three tubercles in each transverse row, and its earlier volutions are represented as marked by similar tubercles, though of course by much smaller ones.

Ammonites (Auctorum.)

The above name being now generally and as it would seem properly restricted to the three-keeled group of shells of which *Ammonites bisulcatus* of Bruguière is the type, can no longer be applied with propriety to any Cretaceous species.

One of the most satisfactory as well as one of the most recent attempts at a re-classification of the great order *Ammonea* of Lamarck is the one published by Dr. Paul Fischer in the first volume of his "Manuel de Conchyliologie,"* whose nomenclature and arrangement will be adopted, with one or two unimportant exceptions, in the following descriptions of the various species of Ammonites collected by Dr. G. M. Dawson at the Queen Charlotte Islands.

* Paris, 1881.

(*Amaltheidæ.*)

Schloenbachia inflata, Sowerby. (Sp.)

Ammonites inflatus, Sowerby. —1817. Mineral Conchology pl. 178.
" *rostratus*, Sowerby. —1817. " " pl. 173.

For the full synonymy of this species, which is too long to insert here, see Pictet & Campiche's Paléontologie Suisse, "Description des Fossiles du Terrain Crétacé des Environs de Sainte Croix," Première Partie, pages 178 and 179.

Bear Skin Bay, Skidegate Inlet: a well preserved and very characteristic cast, which, however, does not shew the septation.

The specimen measures five inches and three-quarters in its greatest diameter and the maximum width of its umbilicus is two inches and a quarter. Its volutions are somewhat squared, and the outer whorl is ornamented by twenty-one large, widely distant and nodulous ribs, which are interrupted or cut through, on the centre of the periphery, by a simple, narrowly rounded and moderately prominent keel. The ribs are mostly simple but occasionally they bifurcate, and on the inner or posterior half of the outer volution they bear four tubercles or nodules on each side of the keeled periphery. On the outer or anterior half of the same volution and especially near the aperture the ribs bear only three tubercles on each side of the periphery, the two inner ones being nearly obsolete, while the outer one rises to a height of fully ten millimetres.

Sphenodiscus Maudensis. (N. Sp.)

Plate 22, figs. 3, 3*a*, and 3*b*.

Shell compressed lenticular: periphery minutely and inconspicuously carinated, the keel being simple, entire, very narrowly rounded, and with parallel sides: inner whorls almost entirely concealed: umbilicus small, about one-tenth of the greatest diameter, with nearly vertical

sides and a subangular margin. Aperture narrowly sagittate or lanceolate with a basal truncation, deeply emarginated by the preceding volution, outside of which emargination its height is more than twice its maximum breadth. Surface smooth. Septum consisting of six lobes and six saddles on each side, not counting the minute siphonal saddle. Siphonal lobe about equal in height to the first lateral, and composed of two main branches (one on either side of the siphuncle), each of which is trilobate at is outer extremity. First lateral lobe scarcely branched, but bearing three minute, irregular toothed lobules, one on each side. Between the siphonal lobe and the first lateral, there is an auxiliary lobe about equal in height to the second lateral. The remaining lobes are simple but minutely incised and decrease gradually in size and height towards the umbilical margin. Siphonal saddle unknown, but obviously very small. First lateral saddle much larger than any of the rest, deeply divided into two spreading branches, which are variously and unsymmetrically lobed and incised. Second lateral saddle somewhat deeply lobed and cut at its outer extremity, but not distinctly branched. The remaining saddles, like the corresponding lobes, are simple but minutely toothed, and decrease regularly in size towards the umbilical margin. Greatest diameter, rather more than forty-nine millimetres: width of umbilicus, four and a-quarter mm.: maximum thickness, eight and a half-mm.

East point of Maud Island, in Skidegate Inlet: one imperfect example.

This shell is very nearly related to the *Ammonites Requienianus** and the *A. Goupilianus*† of d'Orbigny, especially in the character of its septum. From the former, however, it differs in the minute and obtuse carination of its periphery, and from the latter by its much smaller umbilicus.

The septation of *S. Maudensis* is not at all like that of the typical species of *Sphenodiscus*, but the author of that genus is inclined to think that its characters should be enlarged so as to include such forms as *A. Requienianus*. In this connection also, Dr. Fischer writes as follows‡: "Le type de ce genre" (*Sphenodiscus*) "est l'A. *lobatus*, Tuomey. Le groupe des *Clypeiformes* de d'Orbigny (type: *A. Goupilianus* d'Orbigny) correspond assez bien à la coupe générique proposée par Meek."

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* Paléontologie Française, Terrains Crétacés. Tome 1, p. 315. Atlas, pl. 93.

† " " " " p. 317. Atlas, pl. 94, figs. 1-3.

‡ Manuel de Conchyliologie. Paris, 1881. Vol. I., p. 389.

(*Lytoceratidæ.*)

Lytoceras Batesi, Trask. (Sp.)

Plate 27, fig. 1.

Ammonites Batesii, Trask.	—1855. Proceedings of the California Academy of Sciences, p. 40.
" " Gabb.	—1864. Geological Survey of California Palæontology, Vol. I., p. 67, pl. 13, figs. 16 and 16*a–b*.
" " Gabb.	—1869. Idem., Vol. II., p. 132, pl. 20, fig. 9*a*, and pl. 21, fig. 10*a–b*.
Ammonites crenocostatus, Whiteaves.	—This volume, p. 45, pl. 9, figs. 2 and 2*a*.

Bear Skin Bay, Skidegate Inlet: a well preserved but somewhat imperfect specimen, whose maximum diameter is four inches and three-quarters.

A re-examination of the small Ammonite to which the provisional name of *A. crenocostatus* was given on page 45 of the present volume and which was there stated to be "perhaps a half-grown specimen of *Lytoceras Liebigi*, Oppel," has convinced the writer that it is only a young specimen of the *Ammonites Batesi* of Trask, in a somewhat peculiar state of preservation. The sculpture of *A. Batesi*, which is a very typical species of *Lytoceras*, is thus described by Mr. Gabb on page 67 of the first volume of the "Palæontology of California." "Surface marked by numerous fine, rather sharp, elevated ribs, crossing from the interior of the umbilicus obliquely forwards over the dorsum. In some specimens the interspaces are marked by fine revolving lines. In others these lines are absent."

The sculpture of the type of *A. crenocostatus*, upon which the species was mainly based, at first sight appears to consist of rather distant, minutely crenate, transverse raised lines, placed upon the convex surface of the shell, but upon closer examination it is found that these crenulations are caused by minute and underlying revolving striæ, which can only be seen in a certain light.

According to Mr. Gabb,* *A. Batesi* is "the largest known, most widely diffused, and one of the most variable Ammonites" of the Shasta Group; or "older beds" of the Cretaceous formation in California, where it attains to a size of more than a foot in diameter. The same species seems to have also attained to a considerable size at the Queen Charlotte Islands, for in a septate fragment collected by Mr. Richardson in 1872 at Skidegate Inlet, west of Alliford Bay, which cannot be distinguished from *A. Batesi*, the height of the aperture alone is fully

* Palæontology of California. Vol. II., p. 132.

five inches. In this fragment there is no trace of any emargination of the inner surface of the volution, so that the outer whorls of large individuals, though closely contiguous, were probably not embracing.

Lytoceras Sacya, Forbes. (Sp.)

Plate 25.

Ammonites Sacya, Forbes.	—1846. Transactions of the Geological Society of London, Vol. VII. p. 113, pl. 14, fig. 10.
" *Buddha*, Forbes.	—1846. Idem,, Vol. VII. p. 112, pl. 14. fiig. 9.
" *Sacya*, d'Orbigny.	—1850. Prodrome de Paléontologie, Vol. II., p. 213.
" *Sacya*, Giebel.	—1852. Fauna der Vorwelt, Vol. III., p. 557 and 559.
" *Sacya*, Stoliczka.	—1865. Palæontologia Indica, Cretaceous Fauna of S. India, Vol. I., p. 154, pl. 75, figs. 5–7, and pl. 76.
Ammonites filicinctus, Whiteaves.	—1876. This volume, p. 43, pl. 2, figs. 2.

North shore of Cumshewa Inlet, eighteen specimens and some fragments: also Skidgate Inlet, one specimen from each of the following localities, viz., Shingle Bay; east side of Shingle Point; Shore one mile and three quarters south-west of Welcome Point; and Bay east of Alliford Bay.

The largest specimen yet collected at the Queen Charlotte Islands is six inches in its greatest diameter. The reason for regarding *A. filicinctus* as a mere synonym of *A. Sacya*, Forbes, will be found stated in a foot note to page 104 of the present volume, and this conclusion is fully sustained by the much larger and in some respects better series of specimens since collected by Dr. G. M. Dawson.

Lytoceras Timotheanum, Mayor. (Sp.)

Ammonites Timotheanus, Mayor.	—1847. Pictet et Roux. Mollusques des Grès Verts, p. 39, pl. 2, fig. 6, and pl. 3, figs. 1, 2.
" *Jurinianus*, Pictet.	—1847. Idem, p. 41, pl. 3, fig. 3.
" *Timotheanus*, d'Obigny.	—1850. Prodrome de Paléontologie Tome 2, p. 124.
" " Pictet.	—1860. Paléontologie Suisse, Fossiles de Ste. Croix, Vol. I, p. 289.
" " Stoliczka.	—1865. Palæontologia Indica. Cretaceous Cephalopoda of Southern India, p. 146, pl. 73, figs. 3–6.
" " Whiteaves.	—1876. This volume, p. 41, pl. 3, figs. 2 and 2*a*.

South Island, five specimens: Bear Skin Bay, Skidegate Inlet, two

specimens: North shore of Cumshewa Inlet, one fine and nearly perfect example, whose maximum diameter is three inches.

(*Harpoceratidæ.*)

Haploceras Perezianum, Whiteaves.

Ammonites Perezianus, Whiteaves. —1876. This volume, page 19, pl. 2, figs. 1 and 1*a*.
Not *Ammonites Perezianus*, D'Orbigny.—1850. Prodrome de Paléontologie, p. 99.

South Island, Skidegate Channel: two tolerably perfect and typical specimens and two fragments. North shore of Cumshewa Inlet, one example.

In the collection there are also two specimens from South Island which may be referable to this species. The largest of these, whose greatest diameter is fifty seven millimetres, differs from the typical form of *H. Perezianum*, as does the smaller one, in having a more abruptly rounded umbilical margin, and in the greater prominence of the flexuous undulations or plications on the sides, which (plications) frequently bifurcate at a distance about half-way between the umbilical margin and the periphery. These two specimens have evidently very close affinities with the *Ammonites bicurvatus* of Michelin, as figured by d'Orbigny on plate 84, figure 3, of the "Terrains Crétacés," though in the French species the inner face of the whorls is represented as squarely truncated and the umbilical margin as acutely angular.

A. Perezianus, nobis, (*non* d'Orbigny) was originally supposed to be an *Oppelia* nearly related to *O. subcostaria*, Oppel, and *O. Waageni*, Zittel. The specimens obtained by Dr. Dawson, however, seem to show that it is rather an *Haploceras* of the type of *A. bicurvatus*, Michelin, and of *A. Cleon*, d'Orbigny.

As the *Ammonites Perezianus* of d'Orbigny, from the Neocomian of the "departement du Var, de Nice, d'Espagne, etc.," clearly belongs to the genus *Olcostephanus* of Neumayr, there will be no necessity for any change in the name of the present species.

Haploceras Beudanti, Brongniart.

Plate 26, figs. 1 and 1*a*.

Ammonites Beudanti,	Alex. Brongniart.	—1822.	In Cuvier's Environs de Paris, pp. 95, 99, pl. 7, fig. 2.
"	"	d'Orbigny.	1840. Paléontologie Française, Terrains Crétacés, Vol. I., p. 278, pl. 33, figs. 1–3, and plate 34.
"	"	Pictet.	1860. Paléontologie Suisse., Fossiles de Ste Croix, Vol. I., p. 277, pl. 40. With references to other authors.
"	"	Stoliczka.	—1865. Palæontologia Indica., Cretaceous Cephalopoda of Southern India, Vol. I. p. 142, pl. 71, figs. 1–4, and pl. 72.
"	"	Eichwald.	—1868. Lethaea Rossica, Vol. II., sec. 2, p. 1142.

Form **A.**—Umbilical margin rectangular.

Bear Skin Bay, Skidegate Inlet: five specimens, one measuring about three inches and three-quarters, and the others varying from an inch and a-quarter to an inch and three-quarters in their greatest diameter.

Form **B.**—Umbilical margin broadly rounded.

North shore of Cumshewa Inlet: upwards of ninety specimens, most of which are well preserved and nearly perfect, though the outer lip is never entire, and which vary from one inch and a-half to five inches and three-quarters in their maximum diameter.

Brongniart's original description of *A. Beudanti* is not accessible to the writer, but Pictet and Eichwald both agree in stating that its umbilical margin is rectangular. Pictet in particular is very explicit on this point, as may be seen by the following extract from his remarks on the affinities of that species in the first volume of the Paléontologie Suisse:—"Le caractère le plus fixe et le meilleur, dans notre opinion, est le forme même des bords de cet ombilic. Dans l'A. Beudanti les tours sont plats et ne s'infléchissent pas en dedans. L'ombilic est bordé, comme nous l'avons dit, par une muraille verticale dont le sommet est une carène rectangulaire."*

On the other hand, in most of d'Orbigny's and Stoliczka's figures of

* Paléontologie Suisse. Fossiles du Terrain Crétacés des environs de Sainte Croix. Geneva, 1858–60. Vol. I., p. 279.

A. Beudanti the umbilical margin is represented as rounded more or less broadly, and in the text which corresponds to these figures the same part of the shell is nowhere stated to be angulated or carinated.

It would thus appear that there are two forms of the species—one, which may be the most typical and which for convenience has been called Form A, in which the inner face of the sides is squarely truncated, especially in the outer whorl, so that the umbilical margin is rectangular; and the other, or Form B, in which the sides of the outer whorl slope convexly down to the suture, and in which therefore the umbilical margin is rounded.

The specimens from Bear Skin Bay, in Skidegate Inlet, which have already been referred to Form A, correspond perfectly with Pictet's figures of *A. Beudanti* on plate 90 of the first volume of the "Paléontologie Suisse."

All the specimens of this species from Cumshewa Inlet have the umbilical margin rounded, and are therefore referred to Form B. They agree very well in form with most of d'Orbigny's figures of *A. Beudanti*, especially with figures 1 of plates 33 and 34 of the Atlas to the first volume of the "Paléontologie Française, Terrains Crétacés."

The Cumshewa variety of *A. Beudanti* occurs in great abundance in large nodules of argillite. The test is beautifully preserved in these nodules, but it adheres so tenaciously to the matrix that it is almost invariably detached from the cast when the nodules are split open. The cast is marked by distant, very flexuous and obliquely transverse constrictions or periodic arrests of growth. In the specimen figured on plate 26, whose greatest diameter is about five inches and a-half, there are twelve of these flexuous constrictions on the outer whorl, each of which consists of a narrow but rather deep groove, which is sometimes partly margined by a rib-like elevation, especially on the inner side of the groove and near the periphery,—and sometimes not. Small portions of the test sometimes adhere to the cast, and such specimens show that the outer surface of the test is faintly and rather closely ribbed. The ribs are flexuous and run parallel to the distant constrictions on the cast. Near the aperture of the specimen figured, the ribs on a small piece of the shell which happens to be preserved are rather more than one millimetre broad, but a little less than two mm.

At Cumshewa Inlet also a cast of a very large species of *Haploceras* was collected by Dr. Dawson, which is probably a variety of Form B. of *H. Beudanti*. The dimensions of this specimen are as follows:—maximum diameter, twenty-two inches; breadth of aperture and consequently greatest lateral diameter of the shell, eight inches; width of umbilicus, nearly seven inches. The umbilicus has steep walls, but its margin is rather rounded than angular. The outer volution is marked

by about twenty oblique but nearly straight, narrow and widely distant, simple raised ribs, which are more or less acute and which become obsolete upon the periphery. As measured in the centre of one of the sides of the last whorl, these ribs are one inch and a-half apart at the commencement of the volution and two inches and a-half apart at the aperture. A small fragment of the test which remains on the periphery shows that the outer surface of the shell is marked by extremely obscure and rather fine ribs, which average about one line in breadth near the aperture.

According to Stoliczka,* "*Ammonites Beudanti* is, in Europe, characteristic of the Gault, especially of its middle strata; it is known from many localities in France, Switzerland, Germany, England and Russia; and also from the province of Constantine in Algeria." In Southern India it occurs of great size at Odium, Mooraviatoor and Pondicherry, and, as has been already stated, it is by far the most abundant of all the Ammonites collected by Dr. G. M. Dawson at the Queen Charlotte Islands.

Haploceras planulatum, Sowerby. (Sp.)

Plate 28, fig. 1.

Ammonites planulatus, Sowerby.	—1827. Mineral Conchology, Vol. VI., p. 136, pl. 570, fig. 5. (*Not* A. planulatus, Schlotheim.)
Ammonites Mayorianus, d'Orbigny.	—1884. Paléontologie Française, Terrains Crétacés, Vol. I., p. 267, pl. 79.
" *Gaudama*, Forbes.	—1846. Transactions of the Geological Society of London, Vol. VII., p. 113, pl. 10, fig. 3.
Ammonites Mayorianus, Pictet & Roux.	—1848. Fossiles des Grès Verts, p. 37, pl. 2, fig. 5.
" *Griffithii*, Sharpe.	—1854. Fossil Cephalopoda of the Chalk, p. 28, pl. 11, fig. 3.
" *planulatus*, Sharpe.	—1854. Idem., p. 29, pl. 12, figs. 3–4.
" *Mayorianus*, Pictet.	—1860. Paléontologie Suisse, Fossiles de Ste. Croix, p. 283
" *planulatus*, Stoliczka.	—1865. Palæontologia Indica. Cretaceous Cephalopoda of Southern India, Vol. I. p. 134, pls. 67 and 68

North shore of Cumshewa Inlet: one small specimen about three inches and a-quarter in diameter, and two large ones, one ten inches and the other fully eleven inches in their greatest diameter.

* Palæont Indica. Cret. Ceph. of S. India, p. 143.

Stoliczka says "the obsoleteness of the ribs towards the umbilicus" is "generally very constant in this species,"* and Pictet describes the ribs as becoming narrow on the inner half of the sides and as disappearing "vers la moitié des flancs."† In the smallest specimen from Cumshewa Inlet, the original of figure 1 on Plate 28, the ribs are as strongly marked on the umbilical margin as they are on the periphery, though this remark will not apply to the two large specimens from the same locality.

The geographical distribution of *Haploceras planulatum* is very extensive. In the "Palæontologia Indica" it is stated to occur in the Chalk Marl and Upper Greensand of England, in the Gault and "Grès Verts" of France, Savoy and Switzerland, and "it maintains the same geological horizon of the Middle Cretaceous" in Germany, Hungary and the Carpathians. It has also been recognized in the Cretaceous rocks of the Andes of Venezuela, in strata of the same age at Daghestan, as well as from many localities in Southern India.‡

Haploceras Cumshewaense. (N. Sp.)

Plate 24, fig. 1.

Shell composed of few (probably of three or four) strongly compressed whorls, which increase somewhat rapidly in size: periphery narrowly rounded: umbilical margin abruptly truncated at nearly a right angle to the sides: umbilicus about one-fourth the entire diameter and exposing one-half of the sides of the inner whorls. Aperture semi-elliptical, nearly twice as high as broad, squarely truncated at the base and deeply emarginated by the preceding volution.

Surface of the outer whorl marked in the cast by obliquely transverse, flexuous ribs, which are dichotomous, bi-dichotomous, or trifurcating, but rarely simple, also by distant flexuous grooves or periodic arrests of growth, which run parallel to the ribs and which can scarcely be distinguished from the furrows which alternate with each rib except by their being a little broader and deeper. On the last whorl of the only specimen collected there would appear to have been about twelve of these obscurely defined arrests of growth, and the ribs, which are acute and somewhat crowded, are not quite two millimetres apart on the periphery near the aperture.

North shore of Cumshewa Inlet: a single fragment.

This shell may be only a variety of the *Ammonites Brewerii* of Gabb,

* Palæontologia Indica, Fossil Cephalopoda of Southern India, p. 135.

† Paléontologie Suisse, Fossiles de Ste. Croix, Vol. I, p. 284.

‡ Palæontologia Indica, Fossil Cephalopoda of Southern India, pp, 136–137.

which is known to occur at Skidegate Inlet, but its sculpture appears to be quite different. The surface of *A. Brewerii* is described as "variable from nearly smooth, or marked only by sinuous striæ, to strongly costate. the striæ assuming the character of irregular ribs, most marked on or near the dorsum,"* and the ribs of the costate variety figured by Mr. Gabb are invariably represented as simple.

Haploceras Cumshewaense appears also to be nearly related to the *Ammonites Kandi* of Stoliczka, † which Neumayr says is an *Olcostephanus*, ‡ but in the latter species there are said to be only five periodic arrests of growth in the outer whorl.

(Section A.—*Normales.*)

STEPHANOCERATIDÆ.

The sutural line, the comparative size of the chamber of habitation and the shape of the outer lip being unknown in all the specimens collected of each of the four following species, it is difficult to allocate the latter satisfactorily into their proper genera. From the additional evidence afforded by the specimens collected by Dr. Dawson it would however appear that the shells described on pages 29–32 of the present volume with doubt as "Form A." and "Form B." of *Ammonites Loganianus*, are probably two distinct species of *Stephanoceras*, although Drs. Neumayr and Fischer both regard that genus as confined exclusively to rocks of Jurassic Age. The *Ammonites Skidegatensis* described on pages 34–37 of this volume, seems to be a true *Perisphinctes*, as originally supposed, although in its earliest stages it looks more like a species of *Olcostephanus*. The type of *A. Loganianus* § on the other hand, proves to be a distorted example of an *Olcostephanus* (Neumayr) allied to *A. Astierianus* d'Orbigny, which latter shell is regarded as the type of his genus, although its ribs are *not* interrupted on the periphery.

STEPHANOCERAS OBLATUM. (N. Sp).

Ammonites Loganianus, Whiteaves. Form **A**. This volume, p. 29, pl. 4, figs. 2 and 2*a*.

This shell can no longer be regarded a variety of *A. Loganianus*,

* Palæontology of California. Vol. II., p. 130.
† Palæontologia Indica. Cret. Ceph. S. India, p. 140, pl. 70, figs. 4 and 5*a*.
‡ Sitzb. der k. Akad. des Wissensch, 1875, Band 71, p. 41.
§ This volume p. 7, pl. 8, fig. 2.

which, as already pointed out, is an *Olcostephanus*, but as a distinct species of *Stephanoceras* remarkable, as is the next also, for its very close resemblance to some of the Jurassic *Macrocephali*. It can at once be distinguished from the type of *Olcostephanus Loganianus*, as the latter species is now understood, by its smaller size, its narrow umbilicus caused by the much closer enrolment of the whorls, by the almost complete envelopment of the inner volutions and more especially by the broad and deep constriction of the outer whorl immediately behind the aperture.

A perfect specimen of *S. oblatum*, which differs from the original of the figures on plate 4 of the present volume only in being a little smaller, was purchased by Dr. G. M. Dawson from Indians, who stated that it was found in Skidegate Inlet.

Stephanoceras cepoides. (N. Sp.)

Ammonites Loganianus, Whiteaves. Form **B**. This volume, p. 30, pl. 8. figs. 1 and 1*a*.

South Island, Skidegate Inlet: a small but well preserved specimen, whose maximum diameter is about twenty-five millimetres.

This species also seems to differ both generically and specifically from the *Olcostephanus Loganianus* as now restricted. It (the *O. cepoides*) may be at once recognized by its nearly globose form, by the close enrolment of its whorls and consequently narrow umbilicus, also by its sculpture which consists of non-tuberculated and bifurcating primary costæ, which alternate with simple secondary ribs. The analogies between this shell and young specimens of *Ammonites Gervillei*, Sowerby, which is likewise a *Stephanoceras*, have been pointed out on page 31 of the present volume.

Perisphinctes Skidegatensis, Whiteaves.

Ammonites Skidegatensis, Whiteaves. —This volume, p. 34, pl. 7 and pl. 9, fig. 1.

East end of Maud Island: a small but characteristic fragment. An exquisitely perfect specimen of this shell, which measures two inches and a-half in its greatest diameter and which is said to have been collected in Skidgate Inlet, was purchased from Indians by Dr. G. M. Dawson.

Olcostephanus Loganianus, Whiteaves.

Plate 23, figs. 1 and 1*a*.

Ammonites Loganianus, Whiteaves. Type.—This volume, p. 27, pl. 8, fig. 2.
Stephanoceras Humphreysianum, Hyatt. —Geological Survey of Canada, Report of Progress, 1876-77, p. 156: but not *Ammonites Humphreysianus*, Sowerby.

South side of Alliford Bay, in Skidegate Inlet: four well preserved but imperfect specimens.

The type of *Ammonites Loganianus* is a badly distorted cast, which gave a very incorrect idea of the number of the volutions of the shell, of the true amount of their involution, and consequently of the proportionate width of the umbilicus. A nearly perfect specimen of this species has since been collected by Dr. G. M. Dawson, at Sigutlat Lake, B.C., which is figured on plate 23, and this, together with the specimens from Alliford Bay, enable the description of its characters given on pages 27–29 of the present volume to be amended as follows:

When perfect and undistorted, the shell appears to have been composed of about five rounded volutions, which are so lightly enrolled that more than one-half of the sides of the inner ones are exposed. In some specimens the outer whorl is somewhat compressed on the periphery, and in others the sides are slightly compressed. The umbilicus is broad and open, but its margin is indistinctly defined. A row of tubercles on the last volution, from which the primary ribs trifurcate, appears to represent its outer boundary, and assuming this to be the case, then the maximum width of the umbilicus is equal to fully two-thirds of the entire diameter. The aperture is usually, though not always, broader than high, transversely reniform or subcrescentic in outline, and shallowly as well as concavely emarginated at its base by the encroachment of the preceding whorl. The surface is regularly ribbed, and the costation consists of primary trifurcating ribs, with one or two secondary ribs intercalated between each pair of primaries. On the outer whorl the primary ribs commence at the suture and extend nearly half-way across the sides to the outer boundary of the umbilicus, as simple, broad, and distant costæ; then at the umbilical margin each primary rib trifurcates from a transversely elongated and rather prominent tubercle before passing over the periphery. On the same volution the secondary ribs are confined to the outer half of the sides. From this disposition of the ribs it follows that there are usually four or five times as many on the periphery as there are between the umbilical margin and the suture.

The maximum diameter of the largest and most perfect specimen known (that from Sigutlat Lake), is rather more than four inches and and a-half, and the number of primary ribs on its outer whorl is thirty-two. The septation of the species is still unknown.

O. Loganianus belongs to the same setion of the genus as the *O. Astierianus* (which is the *Ammonites Astierianus* of d'Orbigny and Pictet), but its volutions are much more loosely involute, and its umbilicus is far more wide and open. The primary ribs of the outer whorl of *O. Loganianus*, also trifurcate on the middle of the sides, and not comparatively near the suture, as they do in *O. Astierianus*.

(Section B.—*Evolutæ.*)

Ancyloceras Rémondi, Gabb,

Plate 28, figs. 2 and 2*a*.

Crioceras (*Ancyloceras ?*) *Rémondi*, Gabb. —1864. Palæontology of California, Vol. I., p. 75, pl. 14, figs. 24 and 24*a*.

Ancyloceras Rémondi, Gabb. —1869. Idem., Vol. II., p. 138 and 213, pl. 24, fig. 19.

North shore of Cumshewa Inlet, two specimens, the largest of which is figured.

This species is thus described by Mr. Gabb, in the first volume of the Palæontology of California: "Discoidal; whorls increasing rapidly in size, flattened on the sides; dorsal surface narrow, convex; ventral, flat or very slightly concave. Transverse diameter less than half the dorso-ventral. Space between contiguous whorls narrow, but well marked. Surface marked by numerous small flexuous ribs, of about equal size, which arise on the ventral margin of the whorls and pass entirely across the back: these ribs are often dichotomous, and occasionally, though rarely, anastomose near the dorsum. In one case remains of a few dorsal spines were observed. These were placed in two rows, one on each side of the back. The ventral surface is finely striate transversely, the striæ arching forwards. Of the septum, I have only been able to see the dorsal and superior lateral lobes, and their corresponding saddles."

The specimens of *A. Rémondi* from Cumshewa Inlet appear to differ only from the Californian type of the species in being much larger, and in the circumstance that their ribs are more distant and very rarely dichotomous.

Hamites (?) glaber. (N. Sp.)

Plate 24, figs. 2, 2*a*, 2*b*, and 2*c*.

Shell, so far as known, consisting of two straight and parallel limbs of nearly equal size, one of which is bent so closely on the other that the inner surfaces of both are nearly or quite in contact. Sides of both limbs compressed, so that the outline of a transverse section of either would be elliptic ovate, the siphonal edge being slightly narrower than the antisiphonal. Surface apparently smooth, but marked at widely distant intervals by an occasional arrest of growth in the shape of a broad, but faint and shallow, flexuous and transverse constriction, which is obliquely ascending on the antisiphonal half of the limb and nearly straight on the siphonal half.

Each septum in its entire circumference consists of six bipartite saddles and five bipartite lobes. The siphonal saddle is small and simple, though its summit is minutely three-lobed and its sides thrice incised. The three lateral saddles are nearly equal in size, but the second is a little higher than the first, and the third than the second. They are not at all alike in their ramifications, the second or central saddle being twice bipartite and symmetrically or equally divided, while the first and third saddles are unequally divided throughout, the largest half in each case being that which is nearest to the second saddle. At the base of each of the bipartite saddles there is a short incised spur or offset from each side of the stem. Between the first and second and between the second and third lateral saddles there is a small and simple but laterally incised supplementary saddle, but there is none between the siphonal saddle and the first lateral.

The siphonal lobe is equally and twice bipartite. The first and second lateral lobes, which are nearly equal in size and which are slightly larger than the siphonal lobe and much larger than the antisiphonal, are unequally divided throughout. The first lateral lobe is deeply but unequally twice bipartite above, and its stem bears a pair of simple incised branchlets in the middle. The second lateral lobe is deeply divided into two branches of very unequal size, one of which is simply cleft at the summit, while the other is again deeply divided into two branchlets whose apices are also cleft. The antisiphonal lobe is strictly symmetrical, its extremity being regularly trifurcate and the centre of the stem deeply constricted. Alternating with each of the primary and bipartite lobes there is a single but much smaller supplementary lobule, which although incised is not branched.

North Shore of Cumshewa Inlet: three well preserved but fragmentary casts, all of which are figured.

In the Palæontology of California* Mr. Gabb describes a shell which he refers with much doubt, first to the genus *Ptychoceras* or *Hamites*, and finally to *Ancyloceras* under the name *A. quadratus*, which resembles the present shell in its septation, as well as in the fact that its surface is said to be marked with distant periodical constrictions. The outline of a transverse section of *A. quadratus*, however, is described as sub-quadrate and its sculpture is represented as consisting of "very small rounded ribs." The specimens described above are so imperfect that it is impossible to say whether they should be placed in the genus *Hamites*, *Ptychoceras*, *Hamulina*, *Ancyloceras*, or *Anisoceras*, but their sculpture, apart from the periodic constrictions, appears to have been smooth, and they are certainly elliptic ovate in transverse section.

GASTEROPODA.

Nerinæa Maudensis. (N. Sp.)

Plate 27, figs. 2, 2*a*, 2*b*, 2*c*, and 2*d*.

Shell turreted, very long and slender: whorls exceedingly numerous, the early ones obliquely flattened or slightly depressed, the later ones concave in the middle and highest at the suture: suture very indistinct, placed in the centre of a prominent and continuous spiral ridge, which is rounded at the summit. Outline of aperture unknown. Surface of the later whorls encircled by from six to seven fine and thread-like spiral raised lines. Longitudinal sections show that a triangular and acutely pointed spiral ridge or fold revolves around the inner surface of the outer wall of all the volutions.

East end of Maud Island, opposite Leading Island, in Skidegate Inlet: not uncommon in brittle and very friable shale.

As the shale breaks readily in all directions when dry and as the species is long, slender and fragile, the large specimens, which are often much distorted, are invariably broken. The length of the largest fragment collected (fig. 2), which consists of six of the lower volutions, is forty-five millimetres, and its breadth is nine mm. at the smallest end and seventeen mm. at the largest. A very young individual (fig. 2*b*), whose apex is unusually perfect and which measures sixteen mm. (or five-eights of an inch) in length, and a little less than five mm. in breadth at the larger end, has as many as fourteen

* Volume 1, pp. 74 and 75, pl. 14, fig. 21*a*, pl. 15, fig. 21: also volume 2, p. 213.

volutions. Another immature specimen (fig. 2*c*), whose apex is not quite perfect, and which measures twenty-nine mm. (or an inch and a quarter) in length and eight mm. at the larger end, has eleven volutions preserved. The entire number of volutions was probably about twenty.

This species belongs to the sub-genus *Nerinella* of Sharpe.

Cerithium Skidegatense. (N. Sp.)

Plate 27, figs. 3 and 3*a*.

Shell small, not much exceeding half an inch in length, pupiform, turreted but not much elongated, the length being about twice the greatest breadth: whorls six or seven, the earlier ones obliquely compressed, the later ones more cylindrical: spire not much longer than the last whorl preserved, and possibly not any longer than the body whorl, which is more or less broken in all the specimens collected: suture angularly but not very deeply impressed. Surface marked by rows of beaded or tuberculated spiral raised lines. On the two last volutions but one there are four rows of nearly equidistant, prominent and regularly rounded tubercles. On the upper or posterior half of the last volution preserved there are also four rows of bead-like tubercles, and on the lower or anterior half of the same volution there are three or four spiral raised lines, the uppermost of which is indistinctly tuberculated.

Length of the most perfect specimen (in which part of the body whorl is broken off,) eight millimetres; breadth rather more than three and a-half mm.; length of the last whorl (which is imperfect) nearly four mm.

East end of Maud Island, opposite Leading Island: five or six well preserved but imperfect specimens.

Vanikoro pulchella. (Nom. prov.)

Plate 27, figs. 4 and 4*a*.

Possibly a variety of *Lyosoma Powelli*, White.

Comp. Neritina ? ? Powelli, White. —1876. Powell's Report on a Geological Survey of the Uinta Mountains, p. 110.

" *Lyosoma Powelli*, White. —1880. U. S. Geol. Survey, Contributions to Paleontology, Nos. 2–8, p. 153, pl. 30, figs. 6, 6*a*, 6*b*, 6*c*, and 6*d*.

Shell obliquely subovate, its length and breadth being nearly equal:

volutions about three, increasing very rapidly in size, the last one being extremely large in proportion to the rest; spire small, short, obtuse and not raised much above the highest level of the last whorl; last whorl ventricose and much inflated, especially near and at the mouth, imperforate at the base and marked by a shallowly concave spiral groove or constriction above the middle. Aperture large and wide, nearly circular, but angular at the junction of the outer lip with the inner margin of the mouth; peristome thin and nearly continuous, interrupted only by the encroachment of a small part of the preceding volution; inner lip simple, columellar margin devoid of callus, plication, or emargination.

Surface marked with fine and crowded transverse raised lines, and with prominent and nearly equidistant, transverse rib-like folds. On the last whorl the rib-like plications and raised lines which alternate with them in bundles of from three to five or more, extend from the suture to the base and are not confined to the central and posterior portion of the volution.

Length, nine millimetres: maximum breadth, about nine and a-half.

East end of Maud Island, opposite Leading Island: one small but very perfect specimen.

This shell is possibly a mere variety of *Lyosoma Powelli*, which differs from the type of that species only in its much smaller size, less regular contour and in the fact that its transverse striæ and plications cover the whole of the body whorl and are not obsolete on its basal portion. Its greatest diameter is ten mm., while that of *L. Powelli* is said to be twenty-eight mm. On the other hand the Maud Island specimen almost certainly belongs to the genus *Vanikoro* of Quoy and Gaimard, of which *Narica*, Recluz, is a synonym.

Amauropsis tenuistriata, Whiteaves.

Plate 28, fig. 3.

Amauropsis tenuistriata, Whiteaves. —1876. This volume, p. 48. pl. 9, figs. 4 and 4*a*.

Shingle Bay, on Moresby Island, one specimen: Bay east of Alliford Bay, nine specimens: South Island, five specimens. All these localities are in Skidegate Inlet. As the original figure of this species is not very satisfactory an additional one has been given.

Calliostoma constrictum. (N. Sp.)

Plate 28, figs. 4 and 4*a*.

Shell conical, trochiform, length and breadth about equal: whorls four or four and a half, those of the spire obliquely compressed: suture distinct, flattened at nearly a right angle to the sides of the whorls or somewhat excavated: last whorl about two-thirds of the entire length, (in adorsal view) concavely and shallowly constricted or grooved above the midde, most prominent a little below the centre: axis imperforate. Aperture rhombic-ovate, outer lip thin and simple; columella truncated and ending in a prominent tooth-like process anteriorly: inner lip expanded at its base and marked by a shallowly arcuate excavation in front of the tooth-like process on the columella.

Surface marked by numerous and rather fine revolving ribs, which when examined by a lens are seen to be crossed by minute and densely crowded oblique striæ.

Length or height, seventeen millimetres and a-half: maximum breadth, seventeen mm.: height of body whorl, eleven mm.

East end of Maud Island, opposite Leading Island: one fine adult specimen with the whole of the characters of the mouth well shown.

Cinulia pusilla. (N. Sp.)

Plate 28, figs. 5 and 5*a*.

Shell very small, subglobose or broadly subovate in outline, its length and breadth being very nearly equal: spire obtuse, short, about one-fourth of the entire length: volutions three, the first and second obliquely convex, the last large, ventricose and inflated: outer lip thickened and margined exteriorly by a rather broad flat band which is narrowest posteriorly: aperture narrow, ovately subpyriform, rounded in front and pointed behind: columellar lip covered with a callus: columellar folds not clearly distinguishable.

Surface markings consisting of numerous spiral rows of minute shallow punctations, with broader and smooth flat spiral bands between them. On the last volution and near the mouth, there are fifteen or sixteen rows of spiral punctures, which latter are about one half as broad as the smooth flat bands between them. Under an achromatic microscope with an inch and a half objective, these spiral punctations are seen to be transversely oval or somewhat rectangular in outline.

Dimensions of a supposed adult specimen: length, nearly five millimetres: maximum breadth, four mm.: height of last whorl as viewed dorsally, three millimetres and three-quarters.

South Island, in Skidegate Inlet: seven specimens, three of which have the thickened outer lip preserved.

Trochactæon cylindraceus, Stoliczka.

Plate 28, fig. 6.

Trochactæon cylindraceus, Stoliczka.	—1868. Palæontologia Indica. Cretaceous Fauna of Southern India, Vol. II., p. 419, pl. 14, figs. 4, 10-14, as *Actæonella cylindracea*.
Perhaps=*Actæonella oviformis*, Gabb.	—1869. Palæontology of California. Vol. II., p. 173, pl. 28, fig. 58.
Actæonina. (Sp. undt.)	—1876. This volume, page 53.

"Trochact. testa ovato-elongato, cylindracea, antice et postice paulo attenuata, spira plus minusve prominente, obtusiuscula; anfractibus angustis, postice oblique et anguste applanatis, deinde subcarinatis; striis incrementi in superficie ultimi anfractus lente curvatis, apertura longa, postice angustissima, antice latiore ac rotundata; labro ad marginem acutiusculo, levigato, antice oblique late ac lentissime effuso; labio levissimo, postice paulo incrassato, antice triplicato: plica antica tenuissima, postice crassissima." Stoliczka.

East end of Maud Island, opposite Leading Island; one small specimen. A number of crushed, distorted and badly preserved examples of a shell which agree in most particulars with the above quoted description of *T. cylindraceus*, though their columellar folds are very indistinctly shewn, were collected by Mr. James Richardson in 1872, at Skidegate Channel, west of Alliford Bay, probably from exactly the same locality as Dr. Dawson's specimen, which is certainly conspecific with them. As indicated in the synonymy, it is most likely that the *Actæonella oviformis* of Gabb is identical with *T. cylindraceus*.

LAMELLIBRANCHIATA.

Teredo Suciensis, Whiteaves.

Plate 29, fig. 1.

Teredo Suciensis, Whiteaves. —1879. This volume, p. 135, pl. 17, figs. 1 and 1 *a*.

Burrows of a species of *Teredo* which cannot at present be distinguished from *T. Suciensis*, are abundant in pieces of fossil wood col-

lected by Dr. Dawson from rocks of this division on the North Shore of Cumshewa Inlet. Only one specimen of the shell has been seen, which consists of a cast of both valves with most of the test well preserved on the posterior half of each. As the sculpture of the anterior auricle and that of the median area of the valves is not known, the identification of this specimen with *T. Suciensis* is somewhat uncertain.

Martesia carinifera, Whiteaves.

Plate 29, figs. 2 and 2*a*.

Martesia carinifera, Whiteaves. —1876. This volume, p. 54, pl. 9, fig. 7.

Shores of Bear Skin Bay, in Skidegate Inlet: a fine specimen of a colony of the burrows of this species in fossil wood, with several of the shells in situ.

Corbula concinna. (N. Sp.)

Plate 29, figs. 3 and 3*a*.

Shell very small, nearly equivalve, the right valve being a little larger than the left, inequilateral, moderately convex, the thickness through the closed valves being a little less than the greatest height: outline transversly subovate, the length as compared with the breadth being about as seven to five. Anterior end short and regularly rounded at the margin in both valves: posterior end about one-third longer than the anterior, narrowing equally towards its termination, which is obliquely truncated and biangular in the left valve and whose upper angle is rounded off in the right. Cardinal margin rounding abruptly downwards in front, straighter and sloping very gently downwards behind: ventral margin convex and evenly rounded anteriorly, straighter and ascending very gradually posteriorly, most prominent a little in advance of the mid-length. Beaks broad and not very prominent, incurved, inclined slightly forwards and situated about halfway between the centre of each valve and the farthest extremity of the anterior end. On the left valve a distinct umbonal ridge extends from the beaks to the posterior end of the base, and behind and above this ridge the valve is inflected at an obtuse angle. On the right valve the corresponding umbonal ridge is almost obsolete and the posterior area ill-defined.

Surface marked with fine, crowded, and rather irregularly disposed concentric ribs.

Length, seven millimetres; greatest height, five mm.; thickness through the closed valves, four mm.

South side of Alliford Bay, Skidegate Inlet, very abundant and in good condition; Bear Skin Bay, one specimen.

Of the six species of *Corbula* described by Mr. Gabb from the Californian Cretaceous, this little shell comes nearest to *C. parilis*,* but it is much more diminutive in size, more inequilateral, and shows no traces of radiating striæ between the concentric ribs.

Periploma cuspidatum. (N. Sp.)

Plate 29, figs. 4, 4*a* and 4*b*.

Shell compressed but perhaps abnormally flattened; apparently thin and lenticular, nearly equivalve, but very inequilateral: anterior end subcircular in some specimens, more narrowly rounded in others, usually gibbous and somewhat produced at or near the termination of the base in front; posterior end shorter than the anterior, abruptly cuspidate, either rounding more or less regularly upwards and outwards from below, and forming an angular or subangular junction with the hinge line above, or contracting suddenly and concavely above into a short, narrow and upturned beak, of which the hinge line forms the upper boundary. Ventral margin broadly rounded, but sometimes gibbous or subangular in front: superior border convexly arched in front and concave behind. Beaks broad, low, depressed, recurved and placed considerably behind the middle. Posteriorly the beaks are bounded by a single, short, oblique and narrowly linear groove, which indicates the probable existence of a corresponding thin and laminar rib on the inner surface of the posterior umbonal slope in each valve.

Surface apparently smooth or marked only by a few faint concentric striations.

Length in the middle of the valves, twenty millimetres: maximum height twenty-four mm. and a-half.

North side of Maud Island: two specimens with both valves flattened out and a single right valve.

This shell is evidently congeneric with the *Periploma suborbiculatum* described on page 138 of the present volume from a single specimen collected by Mr. James Richardson in 1872 from the Upper Cretaceous rocks of the Nanaimo River, V. I. It may be only a variety of that species, but appears to differ therefrom in its narrowly and shortly beaked posterior extremity, less central beaks and in having only one laminar ridge on the interior of each valve.

The lateral outline of the valves of some specimens of this species is singularly like that of the *Meekia sella* of Gabb,† but the present

* Palæontology of California. Vol. I., p. 150. pl. 29, figs. 239 and 239*a*.
† Palæontology of California. Vol. 1, p. 191, pl. 25, fig. 179.

shell clearly belongs to the *Anatinidæ*, while *Meekia* is supposed to be allied to *Trigonia* or *Tancredia*.

Thracia semiplanata. (N. Sp.)

Plate 29, figs. 5, 5*a*, 5*b* and 5*c*.

Thracia, Sp. Undt.—This volume, page 57.

Shell transversely elongated, compressed, inequivalve, the right valve being moderately convex and the left almost flat; nearly equilateral: anterior end subangular or obtusely pointed below the middle in some specimens, but rounded in others: posterior end about equal in length to the anterior but squared and truncated or subtruncated almost at a right angle to the ventral margin. Superior border very oblique anteriorly, sloping convexly and rapidly downwards and meeting the upward curve of the basal margin at an obtuse angle; behind the beaks the superior border descends also obliquely, but not quite so rapidly, and in some specimens very gently and in a straight line or shallowly concave curve, to its junction with the posterior margin: basal margin nearly straight in the centre. Umbones broad, prominent, and nearly central, beaks slightly depressed, curved strongly inwards and backwards. In well preserved specimens the posterior area is bounded by a sharp, but not very prominent ridge or keel, which extends from the beaks to the posterior end of the base, and behind and above which the valves are obliquely inflected. On the hinge line also, behind the beaks, there is a long and narrow, linear-lanceolate and shallowly excavated ligamental area.

Sculpture somewhat variable; in some specimens the surface is very finely striated, in others the concentric striations are coarser and consist of closely disposed raised lines which are most densely crowded on the posterior area.

Length of a large specimen, fifty-six millimetres; height, thirty-eight mm.; thickness through the closed valves, twenty mm.

Abundant and in a fine state of preservation on the South side of Alliford Bay; Bear Skin Bay, Skidegate Inlet, two specimens; South Island, one specimen.

The above description is intended to express the characters presented by normal and undistorted specimens. In this condition even the species is very variable in form as well as in sculpture. Thus, in some specimens the shell is more or less pointed, though obtusely so, below the middle or near the base anteriorly, in others the anterior margin is rounded. The upper or cardinal margin of the posterior end is

nearly as oblique as that of the anterior end in some specimens, and almost horizontal in others, and again the truncated margin of the posterior end may be either straight or slightly convex.

When distorted, as the specimens frequently are, and in almost every conceivable way, the range of variation in form is, of course, still greater. Some individuals are so much elongated transversely and so narrow in the direction of their height that Pictet's figures of the *Thracia Sanctæ-Crucis*, from the Upper Gault of Switzerland would represent them very accurately, though the normal form, as stated on page 56 of the present volume, is much more like that of the *Thracia* (or *Corimya*) *Nicoleti*, of Agassiz, from the Swiss Lower Neocomian.

This species and *Caryatis subtrigona* are by far the most abundant of the lamellibranchiate bivalves collected by Dr. G. M. Dawson.

Pleuromya subcompressa, Meek.

(Typical form.)

Plate 29, fig. 6.

Myacites (*Pleuromya*) *subcompressa*, Meek.—1873. Annual Report of the United States Geological Survey of the Territories for 1872, p. 472.

" " " " —1877. United States Geological Survey of the 40th parallel, Vol. IV., p. 136., pl. 12. figs 6 and 6a.

? = *Pleuromya papyracea*, Gabb. —1869. Palæontology of California, Vol. II. p. 178, pl. 29, fig. 66.

Beaks prominent and erect: surface marked by concentric plications "that become nearly obsolete on the posterior dorsal region and near the front."

South side of Alliford Bay: a perfect and well preserved cast of the interior of the right valve.

The specimen agrees well with Mr. Meek's description and figure of the type of *Myacites subcompressus* and with Mr. Gabb's diagnosis and figure of *Pleuromya papyracea*, or more properly still of *Panopea papyracea*, as the broad and deep sinus in Mr. Gabb's type shows that it is congeneric with the Cretaceous Panopæas.

Pleuromya subcompressa, var. Carlottensis.

Plate 29, figs. 7 and 7*a*.

Pleuromya Carlottensis, Whiteaves. —1876, This volume, p. 57, pl. 9, fig. 8.
Myacites subcompressus. White, (As of Meek.)—1880, United States Geological Survey. Contributions to Palæontology, Nos. 2–8, pl. 38, fig. 5c; cæt. excl.
Comp. *Pleuromya Newtoni*, Whitfield. —1877. Preliminary Report on the Black Hills, p. 20.
" " " —1880, United States Geographical and Geological Survey of the Rocky Mountain Region, Geology of the Black Hills of Dakota, p. 367, pl. 5, figs. 19 and 20.

Umbones broad and depressed: beaks (or apices of the umbones) curved inwards, downwards and inclined a little forwards: shape, with this exception, and sculpture as in the type of *P. subcompressa*.

South side of Alliford Bay, five casts of the interior: East end of Maud Island, one specimen. On the mainland of British Columbia it occurs also in the porphyrites and felsites of Sigutlat Lake and the Iltasyouco River, where it was collected by Dr. G. M. Dawson in 1876.

The specimen from which the description of *P. Carlottensis* was made is a distorted and imperfect cast, and the figure of it on Plate 9 of the present volume is by no means satisfactory. Although most of the Canadian specimens collected since are also either distorted or imperfect, they show that the shell is very variable in shape, and that it is usually more elongated transversely than the original figure of it might lead one to suppose. The anterior end, which is very short, is excavated under the beaks and abruptly truncated below in the best preserved examples: the posterior end is elongated and either narrowly rounded or somewhat pointed at its junction with the ventral margin.

Some individuals of *P. Carlottensis* appear to be intermediate in their character between *P. Newtoni*, Whitfield, and *P. subcompressa*, Meek, their shape being like that of the former species, and their sculpture like that of the latter. Judging by the figure on Plate 38 of Dr. C. A. White's "Contributions to Palæontology," other specimens appear to be conspecific with the fossil from Devils' Slide, Cinnabar Mountain, Montana, which Dr. White says "may prove to be a different species," but which he regards provisionally as "only a variety of *Myacites subcompressus*." In the writers' judgment, *P. Carlottensis* also is doubtfully distinct from *P. papyracea*, Gabb.

Pleuromya (subcompressa ? var.) lævigata.

Plate 30, figs. 1, 1*a*, 1*b*, and 1*c*.

Myacites subcompressus, White. —1880. United States Geological Survey, Contributions to Palæontology, Nos. 2–8, p. 151, pl. 38, figs. 5*b* and 5*c*: cœt. excl.

Shell compressed, most convex near the anterior margin and somewhat wedge-shaped as seen from above. Valves closed in front, slightly gaping behind, transversely elongated, the length being twice the height in some specimens and less than twice in others, very inequilateral: anterior end short and truncated or sub-truncated at almost a right angle to the ventral margin: posterior end much longer and either rounded or sub-truncated somewhat obliquely at its extremity. Cardinal margin short, excavated and sloping suddenly downwards in front: straighter and descending much more gradually behind: ventral margin nearly straight. Umbones large, broad and prominent: beaks small, curved inwards, downwards and a little forwards, and either anterior and nearly but not quite terminal or placed about half way between the centre of the superior border and its anterior termination. Anterior umbonal ridge obtusely angular and extending from the beaks to the anterior end of the basal margin: in front of this ridge or prominence the valves are bent obliquely and abruptly inwards, and immediately behind it there is a broad and faint shallow depression: posterior umbonal ridge well defined above, but becoming gradually obsolete below.

Surface marked with fine and rather crowded concentric striations. Hinge teeth and muscular impressions unknown.

In two specimens the maximum height is twenty millimetres and the thickness twelve, but the length of the one is forty mm., while that of the other is only thirty-three.

South side of Alliford Bay, nine casts of both valves: East end of Maud Island, three similar casts. This form occurs also in the felsites of the Iltasyouco River, B.C., where it was collected by Dr. G. M. Dawson in 1876. The specimens from this latter locality were doubtfully and as it would now seem erroneously identified with the *Pleuromya subelliptica* of Meek and Hayden in the Report of Progress of the Geological Survey of Canada for 1876-77.

The shells described above appear to be precisely similar to two Montana specimens which are figured by Dr. C. A. White as varieties of *Myacites subcompressus*, Meek, although on the otherhand it is difficult to see how they can be distinguished from some of the Gault

varieties of the *Panopea Neocomiensis* of d'Orbigny, as represented in the "Paléontologie Française" or the "Paléontologie Suisse."

Goniomya. (Species undeterminable.)

South side of Alliford Bay, a very small but well preserved cast, which measures nine millimetres in length by about six or seven in height. A similar specimen has been collected in the Upper Neocomian rocks of the valley of the Fraser River.

Tellina Skidegatensis. (N. Sp.)

Plate 30, figs. 2, 2*a*, and 2*b*.

Shell thin, compressed, transversely elongated, the length being about one-third greater than the height: lateral outline varying in different specimens from ovately and broadly subtriangular to transversely subelliptical. Anterior end somewhat pointed or narrowly rounded: posterior end always a little longer than the anterior, subtruncated and narrowing gradually both above and below, or rounded below and obtusely subangular above. Superior border sloping concavely and rather rapidly downwards in front of the beaks, straighter and descending more gradually behind: ventral margin broadly rounded. Beaks moderately prominent, curved inwards and forwards and placed a little in advance of the middle.

Surface closely and concentrically costulate.

Pallial sinus very obscurely indicated, but apparently broad and rather deep.

Length of a left valve with the test preserved, twenty-six millimetres: maximum height of the same, seventeen mm. In a larger cast the length is forty-one millimetres and the greatest height twenty-six.

Bear Skin Bay, Skidegate Inlet: four or five specimens.

This shell probably does not belong to the typical section of the genus *Tellina*, as exemplified by the recent *T. radiata* of Linnæus and two or three others, but to the subgenus *Tellinella* or *Peronæoderma*. It approaches the *Tellinella petrosa* of Stoliczka,* from the Cretaceous rocks of S. India, in many of its characters, especially in its surface ornamentation, but it is much less pointed at each extremity.

Two casts of single valves of a small *Tellina* which may possibly be

* Pal. Indica. Cret. Faun. S. India. Vol. 3, p. 125, pl. 16, figs. 27-28.

identical with the present species, the most perfect of which is represented by figure 3 of plate 30, were collected on the north side of Maud Island. The specimens from this locality, which do not shew any trace of the two surface markings, are smaller, less elongated transversely in proportion to their height, and more nearly equilateral than the types of *T. Skidegatensis.*

Caryatis subtrigona, Whiteaves.

Callista (?) subtrigona, Whiteaves.	—1876.	This volume, p. 63, pl. 9, fig. 10.
Lucina. Sp. Undt.	"	— "	"	"	p. 61, fig. 6, and pl. 9, fig. 12.
" (?) "	"	— "	"	"	p. 62, fig. 7.

Bear Skin Bay, Skidegate Inlet, extremely abundant: South side of Alliford Bay, apparently not quite so common.

The large series of specimens collected by Dr. Dawson prove conclusively that the fossils doubtfully described on pages 61 and 62 of the present volume as species of *Lucina* are really only distorted and imperfect examples of *Caryatis subtrigona.*

Thetis affinis. (Nom. prov.)

Plate 30, figs. 4, 4*a* and 4*b*.

Probably a variety of *Thetis major,* Sowerby.

Compare *Thetis major,* Sowerby. —1829. Mineral Conchology, Vol. VI., p. 20, pl. 513, figs. 1 to 4.

Shell rather large (for the genus), moderately convex, the thickness through the closed valves being about one-third less than the maximum height; outline variable; in some specimens the lateral contour is transversely ovate-orbicular, the ventral margin being more broadly rounded than the anterior end, and the posterior end narrower and a little longer than the anterior; in others, which are very inequilateral, the valves are ovately subtrigonal as viewed laterally, the short anterior end being subangular at its junction with the superior border above, and the produced posterior end obtusely pointed below the middle. Umbones large and prominent: beaks curved inwards, downwards, and a little forwards, subcentral in some specimens and placed very near the anterior end in others.

Surface marked with rather irregularly disposed concentric lines of growth, and by a few very faint radiating striæ.

Hinge teeth unknown. Muscular impressions transversely elongated

and ovate-lanceolate in outline: pallial border strongly twice inflected: pallial sinus proper very deep, narrow, acutely pointed, extending far into the umbonal cavity, and reaching as far backwards as to within one or two mm. from the tips of the beaks; anterior pallial inflection also very deep, but broader and not extending quite so far backwards as the inner termination of the true pallial sinus.

Dimensions of a specimen which is ovately-orbicular in outline: length, forty-two millimetres, height, thirty-seven and a-half mm.: maximum thickness twenty-three. In an ovately subtrigonal cast of this species the maximum length and height are each fifty mm., and the thickness through the closed valves is thirty-five.

Bear Skin Bay, Skidegate Inlet: eleven specimens.

The very deep double inflection of the pallial border appears to be the only point wherein this shell differs from the *Thetis major* of Sowerby. In other respects the present species seem to be intermediate between the *T. minor* and the *T. major*. Some paleontologists, such as F. Rœmer, E. Forbes, and Mons. Ebray, regard all the nominal species of *Thetis* as varieties of one, which Rœmer proposes to call *T. Sowerbii*, and if this view be adopted, the *Thetis* above described will of course rank only as one of the forms of *T. Sowerbii*.

CYPRINA OCCIDENTALIS. (N. Sp.)

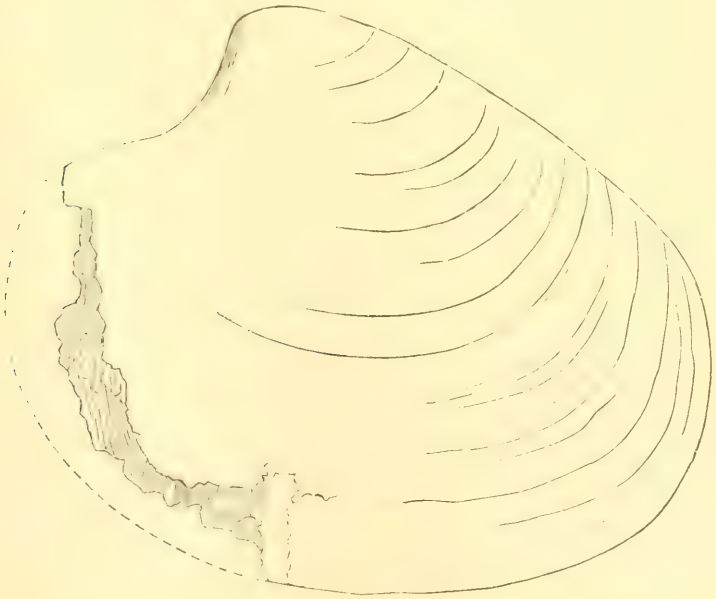

Fig. 10. *Cyprina occidentalis.* Outline of a cast of a left valve.

Shell (or rather cast) compressed, the maximum thickness being a little more than half the height; outline transversely subovate: anterior end short and rather narrowly rounded; posterior end longer and subtruncated below the middle; superior border descending abruptly and concavely in front of the beaks, sloping gradually and somewhat convexly downwards behind; umbones broad and rather prominent, beaks slightly depressed, appressed and directed forwards. Surface marking, hinge teeth and muscular impressions unknown.

Dimensions: length, ninety-four millimetres; height seventy-five mm.; maximum thickness, forty-three.

South side of Alliford Bay: a single imperfect cast.

The specimen is supposed to belong to the genus *Cyprina* on account of its strong resemblance to the *C. ovata* of Meek and Hayden, of which latter species large numbers of fine examples, with the test preserved, have recently been collected by Dr. G. M. Dawson, R. G. McConnell and T. C. Weston at the St. Mary's, Belly and South Saskatchewan rivers. The *C. occidentalis* may be only a variety of *C. ovata*, but it appears to be more transversely elongated, more truncated posteriorly and more gibbous in the umbonal region. The two shells also occur at very different horizons in the Cretaceous formation.

Protocardium Hillanum, Sowerby. (Sp.)

Plate 30, fig. 5.

Cardium Hillanum, Sowerby. —1813. Mineral Conchology, Vol. 1, p. 41, pl. 14, fig. 1.

" " " —1843. Paléontologie Française Terrains Crétacés, Vol. 3, p. 27, pl. 243.

Protocardium Hillanum, Stoliczka. —1871. Palæontologia Indica, Cretaceous Fauna of Southern India, Vol. 3, p. 219, pl. 12. figs. 8–10, and pl. 13, figs. 1–3.

East end of Maud Island, one perfect right valve, with the test preserved, which, however, measures only nine millimetres and a half in its greatest length, and nine in its maximum height. Five small but well preserved casts of a small *Protocardium* from the S. side of Alliford Bay are also believed to belong to this species, though as the specimens from both localities are all very small their specific identification is not altogether free from doubt.

Astarte Packardi, White.

Plate 30, figs. 6, 6*a* and 6*b*.

Astarte Packardi, White. —1880. United States Geological Survey, Contributions to Paleontology, Nos. 2-8, p. 149, pl. 37, figs. 6*a* and *b*.

"Shell subcircular in marginal outline, moderately and almost regularly convex: its length and full height almost equal, or the latter a trifle less than the former; margin forming a continuous subelliptic curve all the way around from the posterior end of the hinge to the lower end of the lunule; hinge margin short and gently convex; beaks placed subcentrally, rather small but prominent, and turned forward; lunule moderately large, rather deeply impressed and clearly defined, its abruptly inflected borders giving a concave appearance to that portion of the shell as seen by lateral view. Surface marked by somewhat numerous and regular concentric undulations, and between these, by minute striæ of growth. Hinge unknown.

Transverse length, twenty millimetres; height from base to beaks nearly one millimetre less." White.

East side of Alliford Bay: four large and beautifully preserved specimens with the test, and a few fragments: South side of Alliford Bay, abundant in the condition of small but perfect casts: East end of Maud Island, five small examples with the test preserved.

The specimens from the above mentioned localities, which the writer has no doubt are correctly identified with *A. Packardi*, give the following additional information about its specific characters. At Maud Island the shell attains to the size of thirty millimetres in length by as many in height. The hinge dentition consists of two transverse cardinal teeth in each valve, and there are no laterals. In the right valve both teeth are most prominent in the middle, but the anterior cardinal tooth is triangular in outline and comparatively large. The inner margin of the valves below and at the side is simple in some specimens and distinctly crenulated in others, as in the recent *A. sulcata* of da Costa.

Dr. White says "This shell is probably not a true *Astarte* as that genus is recognized among living forms, but it probably belongs to a section to to which Gabb gave the name *Eriphyla*.* The type of Sowerby's genus, however, is his *A. lurida* of the Inferior Oolite, whose characters are very near to those of *A. Packardi*.

The three or four imperfect and badly preserved casts from the felsites of the Iltasyouco River, B.C., which were provisionally identified

* Op. cit., p. 149.

with the *A. ventricosa* of Meek on page 155 of the Report of Progress of the Geological Survey of Canada for 1876-77, most probably also belong to the present species.

Unio Hubbardi, Gabb.

Unio Hubbardi, Gabb. —1869. Paleontology of California, Vol. 2, p. 190, pl. 30, fig. 85.
" " Whiteaves.—1876. This volume, p. 65, pl. 9, fig. 13.

Hooper's Creek or King's Tunnel, Cowgitz' coal mine: very abundant. It was collected at the same locality by Mr. Richardson in 1872.

As pointed out on pages 66-67 of the present volume, the hinge dentition shows that the species is a true *Unio* and not a *Margaritana* nor an *Anodon*.

Trigonia diversicostata, Whiteaves.

Trigonia diversicostata, Whiteaves. —1876. This volume, p. 68, pl. 10, fig. 1.

Bear Skin Bay, Skidegate Inlet: three specimens.

Trigonia Maudensis. (N. Sp.)

Plate 31, fig. 2.

Shell moderately convex, longer than high, very inequilateral: anterior end short and rounded: posterior end produced into a rather long and pointed beak, which narrows gradually both above and below, and whose lower margin is somewhat convex and upper margin shallowly concave. Umbones narrow but very prominent, placed about half way between the centre and the farthest extremity of the anterior end; beaks, small, curved inwards and downwards: posterior area well defined and bounded by a rather prominent carina, which is acutely angular near the beaks and obtusely angular behind the middle of the valves.

The front and central portions of the sides of the valves are marked by simple concentric ribs, but at the pointed extremity of the posterior third of the sides these concentric ribs are crossed by a few radiating costæ, which commence at or a short distance below the outer boundary of the posterior area and extend to the ventral margin. In the most perfect specimen, which was collected at Maud Island, there are five radiating ribs on the posterior extremity, two of which, the ones nearest to the anterior end, are comparatively broad, while the three behind them are very narrow and inconspicuous. In two moulds of the exterior of a small *Trigonia* from Cumshewa Inlet, however, which probably

belongs to this species, there are indications of four or five very coarse radiating ribs on the posterior extremity of the sides, all of which are of equal breadth. Posterior area marked by very oblique raised striæ.

Length, thirty-four millimetres: maximum height, from the centre of the umbo to the ventral margin, twenty-four mm.

North side of Maud Island, a perfect but not very well preserved right valve. South Island, one specimen: north side of Cumshewa Inlet: two imperfect moulds of the exterior and one cast of the interior.

This shell may be an extreme variety of the preceding species, from which it differs chiefly in the peculiar ornamentation of its outer surface. It appears to be nearly related to the *Trigonia sulcataria* of Lamarck,* from the "Craie Chloritée" or "Upper Greensand" of France.

Trigonia Dawsoni, Whiteaves.

Plate 31, figs. 1 and 1*a*.

Trigonia Dawsoni, Whiteaves. —1878. Geological Survey of Canada, Report of Progress for 1876-77, p. 154.

"Shell gently convex, compressed; outline ovately-subtrigonal; anterior end very short, broadly rounded, as is also the ventral margin: beaks elevated, recurved, anterior, subterminal: hinge line sloping concavely downwards behind the beaks: extremity of the somewhat elongated posterior end truncated rather obliquely. Surface of the main body of the shell marked by about twelve curved, nodulous costæ, all of which commence at the margin of the posterior area. The five nearest the beaks curve downwards and terminate at the anterior end. The middle ones, though curved, are nearly transverse, and end at the centre of the ventral margin, while the last three incline decidedly backwards. The posterior area is marked either by crowded, transverse, regularly arranged and continuous raised striæ, or by coarse, irregular and broken up or angularly bent, short, tranverse folds. Iltasyouco River and Sigutlat Lake, frequent and well preserved." The above is the original description of the species as it occurs in the volcanic porphyrites of the localities mentioned, on the main land of British Columbia.

South side of Alliford Bay: one fine specimen with the test well preserved on both valves, but with a small piece broken off the posterior end.

The specimen from the Queen Charlotte Islands differs from the types of *T. Dawsoni* in the following particulars, though these differences

* See D'Orbigny. Paléontologie Française, Terrains Crétacés. Vol. 3, p. 150, Atlas, pl. 294, figs. 5-9.

are obviously not of specific importance. In the Alliford Bay shell the number of curved nodulous ribs on the sides of the valves is at least eighteen: its posterior area, in addition to the transverse lines which cover its surface, is marked by three equidistant, curved, longitudinal rows of nodules or nodulous ridges, in each valve, which extend from the beaks to the posterior margin. The lower row of nodules which bounds the posterior area externally, is prominent and composed of comparatively large nodules, but the two upper nodulous ridges are not so prominent and are composed of much smaller nodules.

It is not improbable that *T. Dawsoni* may be only a variety of the *T. Montanaensis* of Meek,* but for the present it is thought prudent not to unite the two forms under one name, for the following reasons. In *T. Montanaensis* the front margin of the valves is said to be ornamented by a transverse row of nodules which latter are "larger than the others and are ranged in a vertical row of strong nodules, which form a conspicuous feature of the shell,"† and its posterior area is described as "marked only by numerous, distinct, nearly vertical lines of growth."‡ There is no such vertical row of large nodules on or near the anterior margin of any of the specimens of *T. Dawsoni*, and on the posterior area of the Queen Charlotte Island variety of that species the transverse raised lines, as already stated, are crossed by three nodulous ridges or longitudinal rows of isolated nodules.

Nucula (Acila) truncata, Gabb.

Nucula truncata, Gabb. —1864. Palæontology of California, Vol. I, p. 198, pl. 26. figs. 184 and 184 *a*, *b*.

Bear Skin Bay and Bay east of Alliford Bay, in Skidegate Inlet: one characteristic specimen from each of these localities.

Nucula solitaria, Gabb.

Plate 31, figs. 3 and 3*a*.

Nucula solitaria, Gabb. —1869. Palæontology of California, Vol. 2, p. 197, pl. 32, fig. 94.

South side of Alliford Ray: nine good casts of both valves with por-

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* See Dr. C. A. White's Contributions to Palæontology, Nos. 2-8. Washington. 1880. P. 147, pl. 38, fig. 2*a*.

† *Ib.*, page 146.

‡ *Ib.*, page 146.

tions of the shell preserved. The specimens, one of which is represented on Plate 31, agree well with Mr. Gabb's description of *N. solitaria*, and are almost exactly of the same dimensions as his type.

Yoldia arata. (N. Sp.)

Plate 31, figs. 4 and 4*a*.

Yoldia. (*Sp. undt.*) This volume, page 72.

Shell small, tumid, transversely elongated and very inequilateral: anterior end narrowly rounded or somewhat pointed in the middle: posterior end about one-third longer than the anterior, attenuated and produced into a straight and narrow or slightly curved and somewhat broad beak. In some specimens the beaked posterior extremity narrows gradually and almost equally both above and below, and its extreme apex is truncated: in others the margin of the posterior end rounds up obliquely from below and forms a subangular or pointed junction with the shallowly concave or straight downward slope of the hinge border above. Umbones small, narrow, projecting very little above the hinge line and placed in advance of the middle: beaks minute, curved inwards and a little downwards, with a slight inclination towards the posterior end. Posterior area linear-lanceolate in outline, as viewed from above, consisting of an abrupt and obtusely angular inflection of each valve behind the beaks.

Surface marked with minute grooves and raised ridges which are very irregular in their disposition, but which as a whole are very nearly concentric. Sometimes the ridges are not continuous, and they are rarely either quite parallel with each other or with the ventral margin. In some specimens, also, the grooves are comparatively broad and separated by exceedingly narrow raised lines: in others the grooves and subangular ridges which alternate with them are equal in breadth.

Dimensions of an average specimen: length, ten millimetres: height, six mm. and a-half: thickness through the closed valves a little over four mm.

South Island, Skidegate Inlet, abundant: Bear Skin Bay, Skidegate Inlet, three specimens: Cumshewa Inlet ("horizon doubtful," G. M. D.), four specimens.

Nemodon Fischeri, d'Orbigny. (Sp.)

Plate 31, fig. 5.

Arca Fischeri, d'Orbigny.	—1850. Paléont. stratigr. 1, p. 369, Paris.
Arca concinna, d'Orbigny.	—(as of Von Buch.) 1845. Géologie de la Russie d'Europe et des Montagnes de l'Oural, Vol. 2, p. 462, pl. 39, figs. 17-18.
Cucullæa Fischeri, d'Orbigny (Sp.)	—Eichwald. 1867. Lethaea Rossica, Vol. 2, p. 559.
Arca concinnata, Graf. Keyserling.	—Petschorareise, p. 306.

"Arca testâ elongatâ, inflatâ, radiatim striatâ: latere buccali, brevi, angustato; latere anali elongato lato, obliquè sinuato; area ligamenti angustatâ.

Coquille très allongée, assez renflée, marquee partout de stries rayonnantes avec lesquelles se croisent quelques lignes d'accroissement concentriques. Côté buccal très court, anguleux du côté de l'area cardinale côté anal très long, élargi, coupé obliquement et échancré à son extrémité. Facette du ligament très longue, étroite, très finement sillonnée. *Dimensions.* Longeur 37 millimetres. Par rapport à la longueur: largeur, 0·40; épaisseur, 0·35; longueur du côté anal, 0·75." d'Orbigny, Geol. de la Russ., &c., Vol. 2, p. 462.

"La figure donnée par M. d'Orbigny montre le bord inférieur légèrement échancré, et l'extrémité postérieure de la coquille pourvue d'une légère carène médiane oblique, située entre la carène obtuse extérieure oblique et le bord cardinal du test; la description de M. d'Orbigny ne fait pas mention de ce caractére." Eichwald, Lethaea Rossica, Vol. 2, p. 559-60. "*Hab.* dans le grès néocomien noirâtre de Khoroschowo" (near Moscow) "et dans le grès blanc compacte à grains de glauconite près d'Orenbourg au mont Isaragoul." Ib., p. 559. At each of these places it is found associated with *Aucella Mosquensis*, which latter shell occurs also at the Queen Charlotte Islands.

Abundant in fine condition at the east end of Maud Island. The hinge dentition shews that it belongs to Conrad's genus or subgenus *Nemodon*.

Grammatodon inornatus, Meek and Hayden.

Plate 31, figs. 8, 8*a*, and 8*b*.

Arca (*Cucullæa*) *inornata*, Meek and Hayden. —1858. Proceedings of the Academy of Natural Sciences of Philadelphia, p. 51.
Grammatodon inornatus, Meek and Hayden. —1862. Idem, p. 419.
" " " " " —1864. Palæontology of the Upper Missouri, p. 90, pl. 3, figs. 9, 9*a* and 9*b*.
" " Whitfield. —1880. Geology of the Black Hills of Dakota, p. 359, pl. 5, figs. 16-18.

North shore of Cumshewa Inlet, one nearly perfect specimen with the valves widely open and partly clasping a valve of *Inoceramus concentricus*.

Skidegate Inlet, south side of Alliford Bay, four specimens: and Bay east of Alliford Bay, one imperfect example.

Cucullæa (Idonearca). Species undeterminable.

Cucullæa (?). Sp. Undt. This volume, page 73.

East end of Maud Island: a crushed and imperfect specimen which, however, has the sculpture well preserved on both valves.

The surface markings consist of very numerous and densely crowded concentric raised lines, which are crossed by radiating striæ. On the posterior and central portions of the sides of the valves the radiating striæ are close together and not much elevated, but near the anterior margin they are distant, prominent and very acute.

Trigonoarca tumida. (N. Sp.)

Plate 31, fig. 6.

Shell inflated, tumid, the thickness through the closed valves being apparently a little greater than their maximum height: valves transversely elongated and very inequilateral: anterior end short, rounding up broadly and obliquely from below and forming a sharply angular junction with the superior border above. Superior border nearly straight both in front and behind, but sloping very gently downwards

in front: ventral margin also nearly straight behind the middle, but obliquely as well as rather abruptly rounded upwards in front. Umbones gibbous and very prominent, placed a little in advance of the middle: beaks distant, curved strongly inwards and downwards, with a slight inclination towards the anterior end: ligamental area deeply and angularly excavated, narrowly subrhomboidal in outline as viewed from above: posterior area obliquely flattened, margined by an obtuse and not very well defined keel. Surface marked with crowded and rather irregularly disposed concentric striations, which are crossed, except upon the posterior area, with numerous radiating raised lines. These latter are most prominent and distinct on the anterior third of the shell. The ligamental area, also, is closely and concentrically striated.

Hinge teeth and muscular impressions unknown.

Dimensions of the only specimen collected: length, eighty-seven millimetres; height, fifty-six mm.; approximate thickness through the closed valves, sixty-four mm.

East end of Maud Island: a perfect and well preserved right valve.

The specimen evidently belongs to a new and interesting species of *Trigonoarca*, which can be easily distinguished from the type of Conrad's genus of that name, the *Arca Ligeriensis* of d'Orbigny, (*) by its very prominent umbones and distinct and numerous radiating raised lines.

Mytilus lanceolatus, J. Sowerby.

Plate 31, figs. 7 and 7*a*.

Mytilus lanceolatus, J. Sowerby.	—1823. Mineral Conchology, Vol. 5, p. 55, pl. 439, fig. 2.
Mytilus edentulus, "	—1823. Mineral Conchology, Vol. 5, p. 55, pl. 439, fig. 1.
Mytilus tridens, "	—1836. In Fitton's paper in the Translations of the Geological Society of London, Vol. 4, Second Series, p. 342, pl. 17, fig. 14.
Mytilus prælongus, "	—1836. *Ib.*, p. 342, pl. 17, fig. 15.
Mytilus lanceolatus, d'Orbigny.	—1844. Paléontologie Française, Terrains Crétacés, Vol. 3, p. 270, atlas, pl. 338, fig. 6.
Mytilus lanceolatus, Pictet.	—1864-67. Paléontologie Suisse, Terrain Crétacé de Ste. Croix, Vol. 3, p. 485, in which a full synonymy of the species may be found.

Shell obliquely compressed above, strongly carinated below the middle, especially in front, and excavated at the base, in such a manner

* Paléontologie Française. Terrains Crétacés. Vol. 3, p. 227, pl. 317.

that the outline of a transverse section through the centre of the valves would be subtriangular, the two upper sides being somewhat convex and the base shallowly concave: maximum thickness, as measured from keel to keel, a little greater than the height. Lateral outline narrowly mytiloid, valves slightly curved and much elongated transversely: anterior end acutely pointed: posterior obtuse: superior border broadly arched but not very prominent: basal margin shallowly concave: beaks anterior, terminal and approximated. Surface apparently marked by coarse concentric striæ of growth, with finer striæ intercalated between them.

Length of the only specimen collected, fifty-six millimetres: height, as measured from the lateral keel to the centre of the hinge line, eighteen mm.: greatest thickness, from keel to keel, twenty-two mm.

Shingle Bay, Skidegate Inlet: a cast of both valves with a very small piece of the test preserved.

The above is a purely original description of the specimen collected by Dr. Dawson, from which it may be seen that its characters do not seem to differ in any essential particular from those of the *M. lanceolatus* of Sowerby as described by d'Orbigny, Pictet and other palæontologists.

Modiola subimbricata, Meek.

Modiola (*Volsella*) *subimbricata*, Meek.	—1873. Annual Report of the United States Geological Survey of the Territories for 1872, p. 472.
" (Sp. undt.)	—This volume p. 73.
Volsella subimbricata, White.	—1880. United States Geological Survey. Contributions to Palæontology, Nos. 2–8, p. 145, pl. 37, figs. 2*a b*, &c.

East end of Maud Island: three distorted specimens, two of which, however, have the test preserved on both valves.

Lithodomus Maudensis. (N. Sp.)

Plate 32, figs. 6 and 6*a*.

Shell convex, the maximum thickness through the closed valves being about equal to their greatest height, most prominent laterally, in the direction of a curved line which might be drawn from the under side of the beaks to the posterior end of the base, beneath and in front of

which slight prominence the valves are abruptly and obliquely compressed as well as somewhat excavated. Length nearly twice as great as the height: lateral outline subelliptical: anterior end truncated inwardly and obliquely under the beaks: posterior end narrowly rounded: superior border regularly, convexly and very broadly arched: ventral margin nearly straight or slightly concave in advance of the middle and as slightly convex behind, forming an obtuse angle with the anterior margin and a rounded junction with the posterior: beaks anterior, terminal and overhanging, approximated and curved downwards as well as inwards.

Surface marked by a few faint concentric lines of growth. In specimens which have the exceedingly thin outer layer of the test exfoliated, however, which is often the case, the outer surface of the inner layer of the shell, when examined under a lens is seen to be marked with crowded radiating striæ which are too minute to be visible to the naked eye.

Length of an average specimen seventeen millimetres: greatest height of the same, nine mm.: maximum thickness, nine mm.

East end of Maud Island: four specimens with both valves.

Oxytoma mucronata, Meek.

Plate 31, fig. 9.

Pteria (*Oxytoma*) *Munsteri*, Meek and Hayden. —1864. Palæontology of the Upper Missouri, p. 80, wood cuts, figs. A, B.

Avicula (*Oxytoma*) *mucronata*, Whitfield. —1876. Palæontology of the Black Hills of Dakota, p. 357. pl. 4, figs. 1, 2.

East side of Alliford Bay, one left valve, which is figured. The same species also occurs in the Lower Sandstones, or sub-division E, of the South side of Maud Island.

The types of *O. mucronata* from the Black Hills of Dakota were originally regarded by Meek, though with much doubt, as possibly identical with the *Avicula Munsteri* of Brown and Goldfuss. Eichwald, however, in the Lethaea Rossica,* says that the sculpture of the left valve of *A. Munsteri* consists of from sixteen to eighteen radiating ribs, with intervals furnished with one to three radiating striæ, whereas in large left valves of *O. mucronata* from Maud Island the primary radia-

* Volume 2, page 504.

ting ribs are separated by wide and nearly flat interspaces, which latter are occupied with as many as eight or nine radiating raised lines, and this seems to be also the case with Meek's figured type of the same species.

In the writer's judgment, the present shell is more nearly allied to the *Avicula Cornueliana* of d'Orbigny, from the French Neocomian,* (which Stoliczka says is an *Oxytoma*) than it is to *A. Munsteri*.

Aucella Piochii. (Gabb.)

Inoceramus Piochii, Gabb. —1864. Palæontology of California, Vol. I, p. 187 pl. 25, fig. 173, (excl. fig. 174.)

Aucella Piochii, Gabb. —1869. Idem, Vol. II, pp. 194 and 247, pl. 31, figs. 92 *a–c*.

Since the first part of the present volume was published a very characteristic valve of this shell was discovered in Mr. Richardson's collection of fossils from the "Lower Shales" of Skidegate Inlet west of Alliford Bay. Although probably only a variety of the *Aucella Mosquensis* of Von Buch, if indeed it is sufficiently different therefrom to rank even as a variety, the occurrence of a specimen of the true *A. Piochii* at this horizon is of considerable interest and worthy of being placed upon record, as throwing some light on the stratigraphical position of the deposit in which it was found.)

Melina Skidegatensis. (N. Sp.)

Melina mytiloides? Lamarck. This volume, pages 80–82, woodcuts, figs. 8 a, b. c, d.

South side of Alliford Bay, in Skidegate Inlet: six large specimens.

The shells described and figured in the first part of this volume, and there regarded, though with much hesitation, as possibly varieties of the *Perna mytiloides* of Lamarck, are now believed to be perfectly distinct.

They appear to belong to a previously undescribed species, for which the name given above is suggested, and to be perhaps most nearly allied to the *Perna Fittoni* of Pictet and Campiché,† from the Lower Greensand of the Isle of Wight and the Gault of Switzerland.

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* Paléontologie Française, Terrains Crétacés, Vol. 3, p. 471, Atlas, pl. 389, figs. 3 and 4.

† Paléontologie Suisse. Fossiles de Ste. Croix. Vol. 4, p. 95, pl. 157, fig. 2.

INOCERAMUS MORESBYENSIS. (Nom. Prov.)

Fig. 11. *Inoceramus Moresbyensis.* Outline of an imperfect left valve to shew the alation of the hinge line behind the beaks.

Shell moderately convex in front, especially in the umbonal region, and obliquely compressed behind : posterior dorsal margin abruptly inflected. Height somewhat greater than the length, greatest length just below the winged expansion of the hinge-line above : anterior margin shallowly concave immediately under the beaks and somewhat convex below : ventral margin rounded narrowly in front and obliquely as well as more broadly so behind : posterior margin obliquely convex below, straighter and widening outwards above. Hinge margin apparently ascending above, behind the beaks, in such a manner as to form a thin alate prominence or expansion whose exact outline is not known but whose posterior margin seems to have been obliquely truncated or subtruncated : beaks anterior, terminal, curved inwards and forwards.

Surface marked with numerous, very irregular and rarely continuous subconcentric plications.

North shore of Cumshewa Inlet, Moresby Island : a few imperfect specimens.

This singular shell, whose characters cannot be very satisfactorily defined with the material at the writer's disposal, appears to belong to that section of the genus of which *Inoceramus alatus*, Goldfuss,* is the type. Judging partly by the figure in the "Petrefacta Germaniæ," and partly by the description ("costis concentricis crassis regularibus") it would seem that the *I. alatus* has much broader and more regularly disposed concentric folds than the present species.

Inoceramus concentricus, Parkinson.

For the synonymy of this well known species, see page 79 of the present volume.

North shore of Cumshewa Inlet, one specimen: Skidegate Inlet, at Bear Skin Bay (one specimen), and very abundant at South Island.

Inoceramus (Actinoceramus) sulcatus, Parkinson.

Plate 32, figs. 3 & 3a.

Inoceramus concentricus,		Parkinson.	—1820. Transactions of the Geological Society of London. Vol. 5, p. 59, pl. 1, fig. 5.
"	"	Sowerby.	—1821. Mineral Conchology, pl. 306, figs. 1-5.
"	"	Goldfuss.	—1836. Petrefacta Germaniæ, page 112, pl. 110, fig. 1.
"	"	d'Orbigny.	—1845. Paléontologie Française, Terrains Crétacés, Vol. 3, p. 504, pl. 403, figs. 3-5.
"	"	Pictet & Campiché.	—1869-71. Paléontologie Suisse, Fossiles de Sainte Croix, Vol. 4, p. 105; which see for a more extended synonymy of the species.

Very abundant at and around Bear Skin Bay, on the Graham Island side of Skidegate Inlet, where thirty-eight good specimens were collected.

In describing this species d'Orbigny says (op. cit. p. 504) that it has seven or ten radiating ribs, but in the Queen Charlotte Island specimens collected by Dr. Dawson the maximum number of ribs is from seven to eight, there are frequently only three and sometimes they are almost obsolete. Pictet, however, in speaking of the ribs of this shell

* Petrefacta Germaniæ. Vol. 1, Divisio Quarta, p. 116, pl. 112, fig. 3.

(op. cit., p. 106,) says, "leur nombre plus frequent est de sept à huit," and adds, "nous avons sur les yeux des echantillons à cinq côtes, et plusieurs même à trois."

Camptonectes curvatus, Geinitz.

Plate 32, fig. 4.

Pecten curvatus, Geinitz.		—1843. Kieslingsw, p. 16, pl. 3, fig. 13.
" " "		—1848. Quadersandstein, p. 180.
Pecten virgatus, d'Orbigny.		—1845. Paléontologie Française, Terrains Crétacés, Vol. 3, p. 602, pl. 434, figs. 7-10, as of Nilsson, but not *P. virgatus* Nilsson.
Pecten (*Camptonectes*) *curvatus*, Stoliczka.		—1871. Palæontologia Indica, Cephalopoda of S. India, Vol. 3, p. 433, pl. 31, figs. 15-16, and pl. 41, figs. 433.
?.=*Camptonectes extenuatus*, Meek.		—1865. Palæontology of the Upper Missouri, p. 78, pl. 3, fig. 6.
" " "	Hall and Whitfield.	—1877. United States Geological and Geographical Exploration of the Fortieth Parallel, Vol. 4, p. 290, pl. 7, fig. 18.
" " "	Whitfield.	—1876. Palæontology of the Black Hilis of Dakota, p. 353, pl. 4, figs. 4, 5.

East end of Maud Island, a single right valve. Judging by the figures and descriptions only it is very difficult to see how the *Camptonectes extenuatus* of Meek is to be distinguished from the *C. curvatus* of Geinitz, assuming that Dr. Stoliczka's synonomy of the latter species is correct, which the writer has no reason to doubt.

Amusium lenticulare. (Nom. Prov.)

Plate 32, fig. 5.

Shell strongly compressed, thin, lenticular; outline as viewed laterally nearly circular, the length and height being very nearly equal: anterior, posterior and basal margins regularly rounded; beaks small, prominent, erect, appressed and central; superior border, exclusive of the ears, descending obliquely, rather rapidly and somewhat concavely on both

sides : ears of the upper or left valve equal in size and similar in shape, ascending obliquely outwards from the beak and truncated also obliquely at the outer margins. Ears of the under or right valve unknown.

Surface of the upper valve polished and nearly smooth to the naked eye, but when examined with a moderately powerful simple lens it is seen to be marked with exceedingly numerous, minute and very closely disposed concentric striæ, also by very faint and somewhat more distant radiating lines. Test extremely thin.

Maximum length of the most perfect valve, forty-two millimetres : height of the same, as measured from the beak to the centre of the basal margin, forty-five mm.

North Shore of Cumshewa Inlet : two or three specimens in a concretionary nodule of shale.

This shell may be a mere variety of the *Camptonectes bellistriatus* of Meek, (see Palæontology of the Upper Missouri, page 77) but the upper margins of the ears of its right valve are ascending and not straight.

Ostrea Skidegatensis. (Nom. Prov.)

Plate 32, fig. 1.

Ostrea. (Sp. Undt.) This volume, page 83.

Fig. 12. *Ostrea Skidegatensis.* Outline of the interior of an upper valve of a separate specimen.

Shell or shells either single and separate or aggregated into clusters of two or three individuals: relative convexity of the two valves variable: shape irregular. Lower valve shallowly convex; upper valve usually flatter and sometimes a little concave. Lateral outline variable in different individuals, no two being alike: as a rule though the single specimens are higher than long, and the clustered individuals are longer than high, while the narrowest part of the valves in all is, as is customary in the genus, at the short hinge line. Thus, of the single or separate specimens some are narrowly elongated in the direction of their height, their dorso-ventral diameter being nearly twice as great as that from the buccal to the anal side, and the two sides are nearly parallel, while others are more or less triangular in their contour and widen out gradually towards the pallial border, though in these also the dorso-ventral diameter somewhat exceeds the maximum length. In clustered specimens, on the other hand, the valves often expand broadly, irregularly and laterally at a short distance from the hinge line, and the buccal margin is broad and nearly straight: in such individuals the length is nearly twice as great as the maximum height, and the greatest length is a little below the middle, as in the original of fig. 1 on plate 32.

Muscular scar large, reniform or subovate, situated near to the buccal margin and about half way between the cardinal and pallial borders.

Surface markings consisting apparently of coarse and irregularly disposed concentric lines of growth.

Skidegate Inlet, south side of Alliford Bay: two single and two clustered specimens. Skidegate Inlet west of Alliford Bay, J. Richardson, 1872: three separate specimens.

The affinity of these oysters is obscure, as the range of variation of the species to which they belong has yet to be ascertained. For the present, however, it will be convenient to designate them by a local and temporary name.

Gryphæa Nebrascensis, Meek and Hayden.

Plate 32, figs. 2, 2*a*, and 2*b*.

Gryphæa calceola, var. Nebrascensis,	M. & H.		—1861. Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. xiii. p. 437.
"	"	"	—1865. Palæontology of the Upper Missouri, p. 47, pl. 3, figs. 1*a–e*, and woodcuts A.B.C.D.
"	"	Whitfield.	—1876. Palæontology of the Black Hills of Dakota, p. 349, pl. 3. figs. 13–16.

(Perhaps a variety of *Gryphæa vesiculosa*, Sowerby.

Compare especially Pictet and Campiche's description and figures of that species in the "Paléontologie Suisse, Fossilés du Terrain Crétacé des environs de Sainte-Croix, 4me. partie," p. 311, pl. 194, figs. 1–6.)

East end of Maud Island, very abundant: South side of Alliford Bay, three good specimens.

The convex valve of the *Gryphæa* from the above mentioned localities, which is the one most commonly preserved, is very variable in its shape and surface ornamentation. In most of the specimens of the larger valve collected by Dr. Dawson the beak is acute, but in others the umbo is distinctly truncated and shows a scar of attachment. The convex valve of some individuals again is evenly rounded on the back and entirely devoid of longitudinal grooves or furrows, but in others the corresponding valve is impressed by a single sulcus, or by two, and in one instance by as many as three radiating and widely distant sulci. The surface of all the specimens of the convex valve collected at the Queen Charlotte Islands is marked by flexuous and concentric lines of growth, but in some the umbonal region is marked also by irregular longitudinal striæ which (as Prof. Whitfield remarks, op. cit. p. 349), "continue to below the middle of the valve," while in others the longitudinal striæ are altogether absent.

The specimens in which the longitudinal striæ are well shown agree perfectly with the descriptions and figures of *Gryphæa Nebrascensis* by the authors above cited, but others in which those striæ are absent can scarcely be distinguished from the *G. vesiculosa* as described and figured by Pictet & Campiché.

Mr. Meek regarded the *G. Nebrascensis* as probably a variety of the *G. calceola* of Quenstedt, but for the reasons just stated it seems quite as likely that it will prove to be conspecific with the *G. vesiculosa* of Pictet & Campiché, if not with the true *G. vesiculosa* of Sowerby.

BRACHIOPODA.

(?) Terebratella obesa, Gabb.

Terebratella obesa, Gabb. ..1864. Palæontology of California, Vol. 1, p. 205, pl. 26, figs. 194 and 194*a*, *b*.

South side of Alliford Bay: one nearly perfect but partly exfoliated dorsal valve, which measures about twenty mm. in breadth by thirteen in length, and whose surface is marked by from twenty to twenty-two subangular ribs, also a smaller example with both valves, but with the

beak of the ventral valve broken off. North side of Maud Island, a young but tolerably perfect specimen.

The Alliford Bay specimens correspond very well with the California types of *T. obesa* in the great convexity of the valves, in being much broader than long, and in being marked with a corresponding number of radiating ribs. The small example from Maud Island looks more like a *Rhynchonella* than a *Terebratella*, but the same remarks would apply to Mr. Gabb's figures of *T. obesa*.

ANTHOZOA.

Astrocœnia irregularis. (N. Sp.)

Plate 33, fig. 1.

Corallum compact, massive, irregular in shape: corallites contiguous, polygonal and mostly hexagonal, averaging from four to five millimetres in diameter: septa arranged obscurely in three cycles and of different length in each: primary septa six, extending from the periphery to the columella: secondary septa six also, but not quite so long as the primaries: between the primaries and secondaries their intervenes a third cycle of twelve short irregular septa: upper and outer edges of the septa, as seen in the calyces, apparently granular; columella styliform, more or less conspicuous in the centre of each calyx but not very prominent: calyces shallow, about one mm. in depth.

South side of Maud Island, two specimens, one of which has been burrowed into by a Lithodomus. The same species was collected by Mr. James Richardson in 1872 in Skidegate channel, west of Alliford Bay.

This coral resembles the *Astrocœnia Reussiana* of Stoliczka * in the number and disposition of its septa, but the corallites of *A. irregularis* are contiguous and from four to five mm. in breadth, whereas those of *A. Reussiana* are said to be distant and only from one to two mm. in breadth.

* Palæontologia Indica, Cretaceous Fossils of S. India. Vol. 4, pt. 4, p. 28, pl. v. figs. 3-5.

4.—From the "Agglomerates," or Subdivision D. of Dr. G. M. Dawson's report.

The only fossils collected from these rocks are three fragments, apparently of the shells of Lamellibranchs, one of which looks rather like a piece of the exfoliated valve of an *Ostrea*, but the specimens are far too imperfect to admit of their specific relations being ascertained.

5.—From the "Lower Sandstones," or Division E. of Dr. G. M. Dawson's Report.

CEPHALOPODA.

Schloenbachia propinqua. (N. Sp.)

Plate 33, figs. 2, 2*a*, 2*b*, and 2*c*.

Shell thin, strongly compressed at the sides, and distinctly keeled on the periphery: maximum thickness about one-fifth of the greatest diameter. Whorls about four, increasing rather rapidly in size in the dorso-ventral direction, but very slowly at the sides: umbilicus about one-third or more than one-third of the maximum diameter, with gently sloping and obliquely convex sides: keel prominent, simple in the largest individuals but more or less crenate in young specimens: aperture nearly twice as high as wide, flattened at the sides, narrowly subelliptical in outline, but emarginated below, though not deeply, by the encroachment of the preceding volution.

Surface marked by numerous and rather crowded flexuous costæ which extend from the umbilical margin to the keel and which are most prominent on the outer half of the sides. In very young specimens the ribs pass over the keel, but in larger ones they are distinctly interrupted or cut through by it. Outer lip broadly concave at the sides and produced on the periphery into an obtusely pointed beak, whose lateral margins are obliquely concave. Septation unknown.

Dimensions of the largest specimen, not counting fragments: maximum diameter forty-nine millimetres: greatest breadth or thickness, ten mm.: width of umbilicus, as measured from suture to suture, eighteen

mm.: height of aperture, nineteen m.m.: maximum width of the same, ten mm.

South side of Maud Island, seven small specimens, the largest of which is not more than twenty millimetres (or a little more than three quarters of an inch) in its greatest diameter. East side of South Bay, in Skidegate Inlet ("probably from Subdivision E." Dr. G. M. Dawson) two specimens, one of which is the largest tolerably perfect one that has yet been obtained.

At the last mentioned locality a large fragment of one of the whorls of this species was collected which shows that the specimen when entire must have been fully four inches in its greatest diameter. The ribs on this fragment are fully five mm. apart, and there are no crenations on its keel. At the South end of Maud Island, associated with the more normal form, there occurs a variety which has a proportionately narrower umbilicus, with somewhat steeper sides, but this variety does not seem to be constant in its characters but to merge gradually into the more typical form.

Young specimens of the present species and of the *Ammonites cordiformis* of Meek and Hayden,* of about three quarters of an inch in diameter, or a little more, are exceedingly alike, but at a slightly advanced stage of growth, the former does not increase much in thickness, and its keel becomes simple and entire, whereas the latter increases very rapidly in thickness as it grows older, and its keel is always serrated.

It is not without precedent for a species of *Schloenbachia* to have a crenate keel in its young state and a simple keel when older, for Stoliczka says that this is the case with his *Ammonites Blandfordianus*,† which Neumayr places in the genus *Schloenbachia*.

Sphenodiscus Requienianus ? d'Orbigny.

Plate 22, figs. 4 and 4*a*.

Ammonites Requienianus, d'Orbigny. —1840. Paléontologié Française, Terrains Crétacés, Vol. 1, p. 315. pl. 93.

South side of Maud Island: a badly preserved cast, which agrees very well, on the whole, with d'Orbigny's description and figures of the above named species, but as the septation is not visible in the specimen collected by Dr. Dawson and as its outer edge is so much water-worn as to obscure the true characters of the periphery, its identity with *A. Requienianus* is rather suggested as possible than decidedly affirmed.

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* See Plate 5 of the "Palæontology of the Upper Missouri," figs. 2*d* and 2*e*.

† Palæontologia Indica. Cretaceous Fossils of S. India, Vol. 3, p. 46.

GASTEROPODA.

Pleurotomaria Skidegatensis, Whiteaves.

Pleurotomaria Skidegatensis. —1876. This volume, p. 51, pl. 9, figs. 6 and 6*a*.

South side of Maud Island: one imperfect and badly preserved but characteristic specimen.

Cinulia. (Species Undeterminable.)

South side of Maud Island: a cast of the body whorl and part of the preceding volution of a subcylindrical and apparently undescribed species with a rather long spire. Very similar specimens, which probably belong to the same species, were collected in the Lower Shales of Skidegate Inlet by Mr. James Richardson in 1872.

LAMELLIBRANCHIATA.

Pleuromya subcompressa, Meek, var. lævigata.

Plate 33, fig 3.

For the synonymy of this shell see page 222.

South side of Maud Island, one very perfect and undistorted cast and a fragment of another. The best specimen from this locality differs a little from the smooth forms of *P. subcompressa* collected from the Lower Shales of Alliford Bay and described on page 224, in being proportionately broader in the direction of their height and in not being so angular on the anterior and posterior umbonal slopes.

A precisely similar example to the one from Maud Island was collected by Mr. G. M. Dawson at the Iltasyouco River in 1876.

Cardium tumidulum. (N. Sp.)

Plate 33, fig. 4.

Shell extremely small for the genus, strongly convex and very tumid in the middle, obliquely compressed at the sides, especially above: greatest thickness through the closed valves about equal to their maxi-

mum length. Valves subovate in outline as viewed laterally, somewhat oblique in some specimens but nearly equilateral in others; higher than long and longest immediately below the middle or near the base: anterior and ventral margins rounded: posterior margin either rounded or obliquely subtruncated and obtusely subangular at its junction with the ventral border below: cardinal border very short, and nearly straight on each side of the beaks, but with its outer angles more or less rounded off: umbones angular behind, subcentral, very broad, gibbous and prominent: beaks curved strongly inwards, downwards and a little forwards: posterior area indistinctly defined.

Entire surface covered with minute and closely arranged radiating ribs. Hinge teeth and muscular impressions unknown.

Dimensions of an average specimen: maximum length, five millimetres and a half: greatest height, six mm.

South side of Maud Island: six badly preserved single valves.

Judging by its external characters alone, it is not at all unlikely that this shell may prove to be a species of *Cardilia* (Deshayes), though that genus has not yet been recorded as occurring in rocks of Cretaceous age. In any case the present species is not a true *Cardium* in the most restricted sense of the word. It may be an extreme variety of the *Protocardium Shumardi* of Meek and Hayden, which latter will be found described and figured on pages 98–99 of the "Palæontology of the Upper Missouri."

Protocardium. (Species undeterminable.)

Plate 33, fig. 5.

South side of Maud Island: a small but perfect cast of a species of *Protocardium*, whose specific relations cannot at present be determined. Its posterior area is marked with rather coarse radiating ribs and the rest of the shell seems to have been concentrically striated.

Nemodon Fischeri, d'Orbigny. (Sp.)

The synonymy of this shell will be found on page 234.

South side of Maud Island: a cast of a left valve.

Lithodomus Maudensis, Whiteaves.

South side of Maud Island: two single valves of a shell which appear to be precisely identical with the species from the "Lower Shales" of the same Island, described on pages 237 and 238 of the present volume.

Oxytoma mucronata, Meek and Hayden.

Plate 33, figs. 6, 6*a*, and 6*b*.

South side of Maud Island; several good specimens of both valves. For critical comments on the characters of this species, with reference to the publications in which it is described, see page 238, ante.

Lima. (Species undeterminable.)

South side of Maud Island: three casts of the left valve of a small, obliquely and narrowly subovate, ribbed species of Lima.

The shell appears to have been rather strongly convex, the front margin is subangular in the middle in one of the specimens and the ears are small. The surface of the central area of the cast is marked by ten radiating ribs, with indications of a minute secondary rib intercalated between each pair of the larger ones, but the outer portions of the anterior and posterior sides are smooth.

Pecten Carlottensis. (N. Sp.)

Plate 33, fig. 7.

Shell compressed, thin, and ovately orbicular, a little higher than long, margin of the valves rounded at and below the middle, narrowing abruptly, obliquely and somewhat concavely under the ears above: shape of the ears not very perfectly known: those of the right valve appear to be small, and unequal in size, the right being rather the larger of the two, triangular, straight above and truncated almost at a right angle at the sides.

Surface marked by about thirty very flat radiating ribs of unequal breadth, which are crossed by minute, exceedingly numerous and densely crowded raised lines, or narrow and acute ridges. The radiating ribs are nearly obsolete in the umbonal region, but are strongly marked on the lower half of the valves, and are separated by narrow and not very deep grooves.

Dimensions of one of the most perfect specimens (the one figured): length, eighteen millimetres: height, twenty.

South side of Maud Island: apparently abundant, but the specimens although well preserved are most of them very fragmentary.

BRACHIOPODA.

Rhynchonella Maudensis. (N. Sp.)

Plate 33, figs. 8, 8*a* and 8*b*.

Shell small, moderately convex, the maximum thickness through the closed valves being usually about one-third less than their greatest breadth: length and breadth nearly equal in most specimens but in others the breadth slightly exceeds the length; outline varying from rounded subtrigonal or broadly and longitudinally subovate to subpentagonal and somewhat transversely elongated: front margin more or less truncated or shallowly emarginated.

Ventral valve tumid in the centre above, and contracting rather suddenly into a broad and not very deep mesial sinus below: beak of the same valve small and pointed, curved inward over that of the dorsal: area small and narrow. Dorsal valve also gibbous and tumid in the umbonal region above, convexly, obliquely and abruptly inflected on both sides of the mesial fold below.

Surface marked with sharply angular, or subangular radiating simple ribs, which extend from the beaks to the anterior and lateral margins. On the ventral valve there are from four to six ribs on the sinus, and seven or eight on each side, while on the dorsal there are from five to seven on the fold, and seven or eight on each side.

Dimensions of a perfect specimen of average size: length eleven millimetres: breadth, eleven: maximum thickness, seven mm. Some individuals are not quite one mm. broader than long, and in others the thickness is equal to nearly one-half the maximum breadth.

South side of Maud Island, abundant and in good condition.

An interesting little shell, which may prove to be only a small local variety of the *R. gnathophora* of Meek. *

Discina semipolita. (N. Sp.)

Plate 33, figs. 9 and 9*a*.

Shell, (or rather upper valve, for the under or attached valve is unknown) depressed conical: height from apex to base about one-half or a little less than one half the greatest breadth of the base: outline of

* Palæontology of California, Vol. 1, p. 39. pl. 8, figs. 1 and 1 *a—f*.

base subcircular or ovately-subcircular, the posterior end being usually a little broader than the anterior, and sometimes nearly straight or faintly emarginate in the centre. Apex erect, obtuse in some specimens and more acute in others, subcentral but always placed a little behind the middle and sometimes as far back as half-way between the middle of the valve and the posterior margin.

Surface polished and shining to the naked eye, but when examined with a somewhat powerful simple lens it is seen to be marked with numerous minute and concentric laminar striæ, and there are traces also of still more minute radiating lines. Test very thin.

Muscular impressions very indistinctly defined: under a lens they appear to consist of two somewhat reniform or arcuate scars, one on each side of the apex, which seem to be divergent posteriorly and convergent anteriorly, though they do not appear to meet in front.

Length of the most perfect specimen figured, seven millimetres: greatest breadth of the same, six mm. and a-half: approximate height, three mm.

South side of Maud Island: eight upper valves, or casts of the upper valve.

As the number and shape of the muscular scars on the interior are by no means clearly apparent, it is just possible that this shell may be a *Helcion*, but its character, on the whole, are much more like those of a *Discina*.

GENERAL CONCLUSIONS.

1. The Upper Shales and Sandstones, or Subdivision A.

These rocks, which so far as known contain *Inoceramus problematicus* only, probably represent the lowest division of the Upper Cretaceous.

2. The Coarse Conglomerates, or Subdivision B.

No fossils that can be identified specifically have yet been collected from these deposits, but from their stratigraphical position they may be presumed to be synchronous with the Upper Greensand, or Craie Chloritée of the French Geologists, and with the Shales and Sandstones of the "Dakota Group."

3. The Lower Shales, or Subdivision C.

The Lower Shales are remarkable not only for the occurrence in them of anthracite coal and clay ironstone, but also for the abundance and great variety of the fossils which they contain. As the fossils collected by Dr. Dawson are not all from precisely the same geological horizon in these shales, it will be desirable to give a list of the species from each locality before discussing the probable age of the series as a whole.

A.—From Cumshewa Inlet.

No. 1. "Fossils from the Peninsula, north shore of Cumshewa Inlet and at different places a few miles west of the Peninsula. All from about the same geological horizon, which is supposed to represent subdivision C of the Skidegate section." (Dr. G. M. Dawson.)

Spiroceras Carlottense.
Lytoceras Sacya.
" Timotheanum.
Haploceras Perezianum.
" Beudanti (abundant.)
" planulatum.
" Cumshewaense.
Ancyloceras Rémondi.
Hamites glaber.
Teredo Suciensis.
Trigonia Maudensis.
Arca, like grammatodon inornatus.
Inoceramus Moresbyensis.
" concentricus,
Amusium lenticulare.

No. 2. "Fossils from the lowest beds recognized at Cumshewa." (G. M. D.)

Haploceras Perezianum.
Yoldia arata.
Trigonia Maudensis.
Amauropsis tenuistriata.

B.—From Skidegate Inlet.

No. 3. "From Shingle Bay: probably from subdivision C." (G. M. D.)

Lytoceras Sacya.
Haploceras Beudanti.
Amauropsis tenuistriata.
Mytilus lanceolatus.

No. 4. "From the east side of Welcome Point: probably C." (G. M. D.)

Lytoceras Sacya.

No. 5. "From shore one mile and three quarters south-west of Welcome Point: probably C." (G. M. D.)

Nautilus Suciensis.
Lytoceras Sacya.

No. 6. "From Bear Skin Bay: C." (G. M. D.)

Schloenbachia inflata.
Lytoceras Batesi.
" Timotheanum.
Martesia carinifera.
Corbula concinna.
Thracia semiplanata.
Tellina Skidegatensis.
Thetis affinis.
Callista subtrigona.
Trigonia diversicostata.
Nucula (Acila) truncata.
Yoldia arata.
Inoceramus concentricus.
Actinoceramus sulcatus.

No. 7. "From the east side of Alliford Bay: near base of C." (G. M. D.)

Belemnites (densus, var.) Skidegatensis.
Astarte Packardi. Very large.
Oxytoma mucronata.

No. 8. "From the south side of Alliford Bay: near base of C." (G. M. D.)

Belemnites Skidegatensis.
Olcostephanus Loganianus.
Corbula concinna.
Thracia semiplanata.
Pleuromya subcompressa. Type.
" " var. Carlottensis.
" " var. lævigata.
Callista subtrigona.
Cyprina occidentalis.
Protocardium Hillanum?
Astarte Packardi.
Trigonia Dawsoni.
Nucula solitaria.
Grammatodon inornatus.
Melina Carlottense.
Ostrea Skidegatensis.
Gryphœa Nebrascensis. (Or G. vesiculosa.)
? Terebratella obesa.

No. 9. "From the east end of Maud Island: base of C." (G. M. D.)

Sphenodiscus Maudensis.
Perisphinctes Skidegatensis.
Nerinæa Maudensis.
Cerithium Skidegatense.
Vanikoro pulchella.
Calliostoma constrictum.
Trochactæon cylindraceus.
Pleuromya subcompressa, var. Carlottensis.
" " var. lævigata.
Protocardium Hillanum?
Astarte Packardi.
Nemodon Fischeri.
Trigonoarca tumida.
Modiola (Volsella) subimbricata.
Lithodomus Maudensis.
Camptonectes extenuatus. (Or C. curvatus.)
Gryphœa Nebrascensis. (Or G. vesiculosa.)

No. 10. "From the north side of Maud Island: C." (G. M. D.)

Periploma cuspidatum.
Tellina Skidegatensis? var.
Trigonia Maudensis.

No. 11. "From South Island: C." (G. M. D.)

Haploceras Perezianum.
" Timotheanum.
Stephanoceras cepoides.
Amauropsis tenuistriata.
Cinulia pusilla.
Thracia semiplanata.
Trigonia Maudensis.
Yoldia arata.
Inoceramus concentricus.

No. 12. "From Hooper's Creek Tunnel: (G. M. D.)

Unio Hubbardi.

No. 13. "From Coal Locality, south side of Skidegate Channel: base of C." (G. M. D.)

Belemnites densus.

No. 14. "From Bay east of Alliford Bay: (G. M. D.)

Amauropsis tenuistriatus.
Nucula (Acila) truncata.

No. 15. "From the south side of Maud Island: base of C." (G.M.D.)

Astrocœnia irregularis.

On the evidence afforded by the fossils as well as on stratigraphical grounds it would appear that the rocks at both localities in Cumshewa Inlet and at Nos. 3, 4, 5, 6, 10, 11 and 14 in Skidegate Inlet are unquestionably Cretaceous; that they represent the lower half of the Middle Cretaceous, and that they are as nearly as possible the exact equivalents of the Gault of Europe.

At these localities the Lower Shales contain, among others, the follow-

ing European Middle Cretaceous species, most of which are eminently characteristic of the Gault:—

Schloenbachia inflata, Sby.	Thetis (major, var.) affinis.
Haploceras Beudanti, Brngt.	Mytilus lanceolatus, Sby.
" planulatum, Sby.	Inoceramus concentricus, Park.
Lytoceras Timotheanum, Mayor.	Actinoceramus sulcatus, Park.

And probably

Camptonectes curvatus, Gein. & Gryphæa vesiculosa, Sby.

As might be expected, under the circumstances, some of the fossils of the Lower Shales range downwards into the Upper Neocomian or latest division of the Lower Cretaceous, while others extend upward into the Upper Cretaceous.

Those species which have the downward range indicated are,—*Ancyloceras Rémondi*, Gabb: *Aucella Piochii*, Gabb, which latter though rare in the Lower Shales of Skidegate Inlet is abundant in the Upper Neocomian of the mainland of British Columbia: *Nemodon Fischeri*, d'Orbigny, a Russian Neocomian fossil: and *Syncyclonema Mackani*, Wh., which is found also in the upper Neocomian of the valley of the lower Fraser river, B.C.

Those which range upwards into the Upper Cretaceous are *Nautilus Suciensis* and *Teredo Suciensis*, Whiteaves, both of which occur also in the Upper Cretaceous of the Sucia Islands, also *Nucula (Acila) truncata*. *Nucula solitaria and Terebratella obesa* of Gabb, which were originally described from the Chico Group of California.

Two species which have been described and figured by Stoliczka in his Cretaceous Fauna of Southern India, viz., *Ammonites Sacya*, Forbes, which Neumayr says is a *Lytoceras*, and *Trochactæon cylindraceus*, Stoliczka, are abundant in the Lower Shales of Cumshewa and Skidegate Inlets, the former at four localities, viz., Nos. 1, 3, 4 and 5, the latter so far as known, at Maud Island only, or No. 9.

Some of the fossils of the Lower Shales occur also in the "Shasta Group" of California. These are *Ammonites Batesi*, Trask, which is a *Lytoceras: Ammonites Breweri*, Gabb, which is a *Haploceras: Ammonites Stoliczkanus*, Gabb, which is most likely a *Hoplites: Ancyloceras Rémondi*, Gabb: *Aucella Piochii*, Gabb: and probably also *Pleuromya papyracea*, Gabb.

In a paper "on the Lower Cretaceous Rocks of British Columbia," which was published in the first volume of the Transactions of the Royal Society of Canada, the writer endeavoured to show that the

"Shasta Group" of the Californian geologists is separable, on palæontological grounds, into two well-marked divisions, one of which represents the Upper Neocomian and the other the Gault of Europe. The localities in British Columbia at which these supposed Upper Neocomian rocks occur, and a list of the fossils of the latter, with descriptions of three new species, are given in the paper cited. On the Pacific Coast of the United States and Canada the most characteristic fossils of the equivalents of the Upper Neocomian appear to be the *Belemnites impressus*, *Ancyloceras percostatus* and *Aucella Piochii* of Gabb, which latter shell is almost unquestionably synonymous with *A. Mosquensis* Von Buch, of the Russian Neocomian.

The Gault of Europe seems to be represented in America, not only by the Lower Shales of the Queen Charlotte Islands, as already suggested, but also by the fossiliferous porphyrites and felsites of Sigutlat Lake and the Iltasyouco river, B.C. (which were formerly supposed by the writer to be of Jurassic age) and by those Californian rocks which were formerly included in the Shasta Group and which hold such fossils as *Lytoceras Batesi*, *Haploceras Breweri* and *Hoplites Stoliczkanus*.

At the base of the series, however, in Skidegate Inlet, at localities Nos. 7, 8, 9, 13 and 15, in rocks which, according to Mr. Richardson and Dr. Dawson form part of the Lower Shales, and associated with others that elsewhere occur mingled with purely Cretaceous types, there occur a few fossils which the writer has entirely failed to distinguish from the following species that have heretofore been regarded as Jurassic by American geologists.

Belemnites densus, Meek & Hayden.	Modiola (Volsella) subimbricata, Meek.
Pleuromya subcompressa, Meek. (Several varieties.)	Oxytoma Nebrascensis, Meek & Hayden.
Astarte Packardi, White.	Camptonectes extenuatus, M. & H.
Grammatodon inornatus.	Gryphæa Nebrascensis, M. & H.

Moreover, the *Vanikoro pulchella* of the Lower Shales is possibly only a variety of *Lyosoma Powelli*, White: the *Cardium tumidulum* of the Lower Sandstones may be an extreme form of the *Protocardium Shumardi* of Meek and Hayden, while the *Rhynchonella Maudensis* from the same rocks is very likely only a small local variety of the *R. gnathophora* of Meek.

Further, the fossiliferous volcanic rocks of Sigutlat Lake and of the Iltasyouco River on the mainland of British Columbia (which are now believed by the writer to be of the same age as the Lower Shales, as the two formations contain seven species in common, namely, *Olcoste-*

phanus Loganianus, *Pleuromya subcompressa*, *Astarte Packardi*, *Trigonia Dawsoni*, *Grammatodon inornatus*, *Camptonectes extenuatus* and *Gryphæa Nebrascensis*) hold also *Modiola* (or *Volsella*) *formosa* of Meek and Hayden, and *Gervillia Montanaensis* of Meek.

The discovery in the Black Hills of Dakota of deposits which were supposed to be of Jurassic age, principally upon palæontological grounds, was first announced by Mr. F. B. Meek in 1858, and since that time numerous species of fossils from rocks of a similar geological horizon in Utah, Montana and other Western States and Territories, as well as in California, have been described by Mr. Meek, Professor R. P. Whitfield and Dr. C. A. White.

The reasons which induced Mr. Meek to regard certain strata in Utah and Dakota as Jurassic are clearly stated on pages 110 and 111 of Dr. Hayden's "Geological Report of the Exploration of the Yellowstone and Missouri Rivers" and elsewhere, but the conclusions at which Mr. Meek arrived, with the somewhat meagre material at his disposal, although such as any palæontologist would probably have come to under the circumstances, appears to the writer to be outweighed by the additional evidence afforded by the large collection of fossils since made by Mr. Richardson and Dr. Dawson at the Queen Charlotte Islands and on the mainland of British Columbia, which throw an entirely new light on the subject.

Throughout the Western States these supposed Jurassic rocks are everywhere stated to occupy a position immediately below the sandstones and conglomerates of the "Dakota Group" (which Meek maintains is the equivalent of the English Upper Green Sand) and as immediately above certain red beds which are generally believed to be Triassic. Wherever these ostensibly Jurassic rocks occur, therefore, it follows that part of the Mesozoic series is wanting, and it is difficult to understand why the Lower Cretaceous and earlier half of the Middle Cretaceous should always be missing and not the Jurassic.

As will be seen a little farther on, there are good reasons for supposing that the Agglomerates and Lower Sandstones of the Queen Charlotte Islands form part of the same formation as the Lower Shales, but, whether this be the case or not, the three together occupy almost exactly the same stratigraphical position as the supposed Jurassic rocks of the Western States. At Cumshewa and Skidegate Inlets the Lower Shales immediately underlie conglomerates which are probably synchronous, or nearly so, with those which almost invariably occur at the base of the "Dakota Group," and the Lower Sandstones are succeeded by Upper Triassic rocks, although the two latter are unconformable.

Turning next to the palæontological aspect of the question, Mr.

Meek's principal argument in favour of regarding the Dakota and Utah rocks as Jurassic is thus stated in that report of Dr. Hayden's to which reference has already been made. "The organic remains found in these series present, both individually and as a group, very close affinities to those in the jurassic epoch in the Old World; so close indeed, that in some instances, after the most careful comparisons with figures and descriptions, we are left in doubt whether they should be regarded as distinct species, or as varieties of well known European jurassic forms. Among those so very closely allied to foreign jurassic species may be mentioned an *Ammonite* we have described under the name of *A. cordiformis*, which we now regard as probably identical with *A. cordatus*, of Sowerby; a *Gryphæa* we have been only able to distinguish as a variety from *G. calceola*, Quenstedt; a *Pecten*, scarcely distinguishable from *P. lens*, Sowerby; a *Modiola*, very closely allied to *M. cancellata*, of Goldfuss; a *Belemnite*, agreeing very well with *B. excentricus*, Blainville, &c."

The strongest point in this argument is the fact first adduced, namely, the occurrence in the rocks in question of an Ammonite (*A. cordiformis* of Meek and Hayden) which seems to be an *Amaltheus* or a *Cardioceras*, and in either case is a species which is very closely related to the *Ammonites cordatus* of Sowerby from the European Jurassic. But, on the other hand, associated with purely Cretaceous types, the Lower Shales of Skidegate Inlet contain no less than four species of Ammonites which if submitted to any European palæontologist who had made a special study of the group, without shewing him any other fossils from the same rocks, would almost certainly be regarded as Jurassic. These are *Ammonites Richardsoni*, Whiteaves, which is a very typical representative of the *Coronarii* of Von Buch, and which therefore is probably a *Stephanoceras: Stephanoceras oblatum* and *S. cepoides*, whose relations to the Jurassic *Macrocephali* have been pointed out on pages 29, 30, 209 and 210 of the present volume; and *Perisphinctes* Skidegatensis, Whiteaves, which as Mr. E. Billings suggested, (on page 72 of the Report of Progress of the Geological Survey of Canada for 1872–73) is of the type of *P. tyrannus*, Neumayr, from the "Macrocephalen Kalken" of Brielthal.

In regard to the *Gryphæa Nebrascensis*, which Mr. Meek thought was possibly a variety of *G. calceola*, Quenstedt, the specimens from Skidegate Inlet shew that the irregular radiating striæ on the umbonal region of the convex valve are as often absent as present, and apart from this character it is difficult to see how the shells represented by Meek's woodcuts of *G. Nebrascensis* in the "Palæontology of the Upper Missouri" can be distinguished from the *G. vesiculosa* of Sowerby as figured by Pictet and Campiché.

The *Camptonectes bellistriatus* of Meek and Hayden, from the Black Hills of Dakota, looks more like a Cretaceous *Amusium* or *Camptonectes* than it does like the true *Pecten lens* of Sowerby, which latter species the writer has had abundant opportunities of studying in the field, in the Middle and Lower Oolites of the midland counties of England. *Camptonectes extenuatus* of Meek and Hayden, as figured by Prof. R. P. Whitfield in the "Palæontology of the Black Hills of Dakota," bears a remarkably close resemblance to the *C. curvatus* of Geinitz, from the Cretaceous rocks of Southern India, as described and illustrated by Stoliczka.

The *Modiola* (or *Volsella*) *formosa* of Meek and Hayden belongs to a persistent and recurrent section of that genus, which ranges from the Jurassic epoch into the recent period, and which is represented in northern seas by the *Modiolaria nigra* of Gray.

The very variable guards of Belemnites from the Black Hills and elsewhere, which Mr. Meek described provisionally under the name *B. densus*, may represent two or three species rather than one, and neither of them seem to present any special characters by which they can be distinguished as Jurassic species rather than Cretaceous.

Oxytoma mucronata, Meek, for reasons already stated on pages 238 239, appears to be more nearly related to the *O. Corneuiliana* of d'Orbigny, from the French Neocomian, than to the *O. Munsteri*, Goldfuss, of the Jurassic, and the typical form of the *Pleuromya subcompressa* of Meek, seems also to be barely separable from the *Pleuromya* (or *Panopæa*) *papyracea* of Gabb, from the "Shasta Group" of California.

From the foregoing considerations the writer has long held the opinion, first, that the whole of the Lower Shales at Cumshewa and Skidegate Inlets belong to about the same geological horizon as the Gault of England and Europe: and secondly, that there are now good reasons for supposing that many of those rocks in the Western Territories and California which have been hitherto regarded as Jurassic may prove to be more nearly the equivalents of the earliest or oldest subdivision of the Middle Cretaceous.

4. "The Agglomerates, or Subdivision D."

There is no palæontological evidence which would afford any clue to the probable age of the rocks of this subdivision.

5. "The Lower Sandstones or Subdivision E."

Fourteen species of fossils were collected by Dr. Dawson in these deposits, but three of the former are too imperfect to be determined. Of the eleven species which remain, five, namely, *Pleutomaria Skidegatensis, Pleuromya subcompressa, var. levigata, Nemodon Fischeri, Oxytoma mucronata* and *Lithodomus Maudensis*, occur also in the Lower Shales, especially towards or at their basal portion: one is doubtfully identified with the *Ammonites Requienianus* of d'Orbigny, which is probably a *Sphenodiscus:* and five (viz., *Schloenbachia propinqua, Cardium tumidulum, Pecten Carlottensis, Rhynchonella Maudensis*, and *Discina semipolita*) are here described and figured as apparently new.

As nearly one-half of the species collected in subdivision E are also found in subdivision C, it is upon the whole most likely that the Lower Shales, the Agglomerates and Lower Sandstones of Dr. Dawson's report, are all merely local and subordinate subdivisions of the same formation, and that the three together represent the lower half of the Middle Cretaceous at this particular locality. It is to be noted, however, that the two Ammonites which occur in the Lower Sandstones are quite different from any of the species found in the Lower Shales.

ADDENDUM.

Trigonia intermedia, Fahrenkohl.

Lyriodon intermedium, Fahrenkohl.	—1841.	"Üb. einige Fossilien der moskausch u. kalug. Gouv. voy., Bull de Mosc." Vol. iv. p. 796, pl. 19, fig. 2.
Lyrodon clavellatus, G. de Fischer.	—1853.	Bull de Mosc, Vol. 1, p. 127.
Trigonia clavellata, d'Orbigny.		(En partie). Paléont. de Russie, &c., p. 460.
Trigonia intermedia, Eichwald.	—1867.	Lethaea Rossica, Vol. 2. Sect. 1, p. 601, pl. 24, figs. 13 *a* and *b*.
Trigonia Dawsoni, Whiteaves.	—1878.	Geol. Surv. Can., Rep. Progr. 1876-77, pp. 154 and 155.
" " Whiteaves.	—1884.	This Volume, p. 231, pl. 31, figs. 1 and 1*a*.

Since the third sheet of the present report was issued, the writer has ascertained that the *Trigonia Dawsoni* is almost certainly identical with the above named Russian Neocomian species.

PLATE XXI.

NATILUS SUCIENSIS, Whiteaves, (page 197).

Side view of a specimen from Skidegate Inlet.

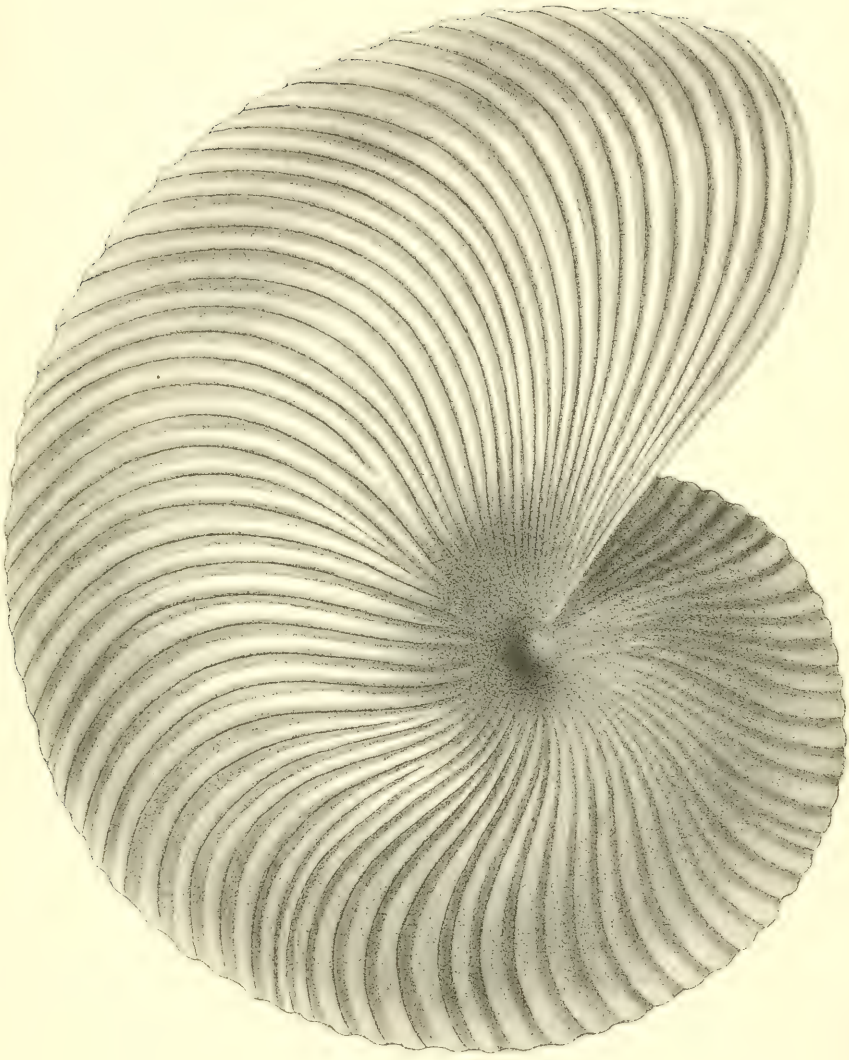

PLATE XXII.

Belemnites densus, Meek & Hayden, (page 194).

Figure 1. Side view of the only guard collected, from the south side of Skidegate Channel, which is thought to be probably referable to this species.

Belemnites Skidegatensis (page 195).

Figure 2. Specimen from Alliford Bay in Skidegate Inlet, showing the phragmocone in situ and a large portion of the guard.

" 2 *a*. Another example of the guard, also from Alliford Bay.

" 2 *b*. Ventral aspect of the same.

" 2 *c*. Natural transverse section of a specimen of the guard, not far from the apex of the phragmocone.

Sphenodiscus Maudensis (page 200).

Figure 3. Side view of the only specimen known, from the east point of Maud Island.

" 3 *a*. Outline of a transverse section of the same.

" 3 *b*. Portions of two septa of this species.

Sphenodiscus Requienianus (?) d'Orbigny, (page 248).

Figure 4. Cast of the interior of a shell which is doubtfully referred to this species, from the south side of Maud Island.

" 4 *a*. Outline of the same, as viewed at a right angle to the last, to show the comparative thickness of the shell, the shape of its aperture and the characters of the periphery.

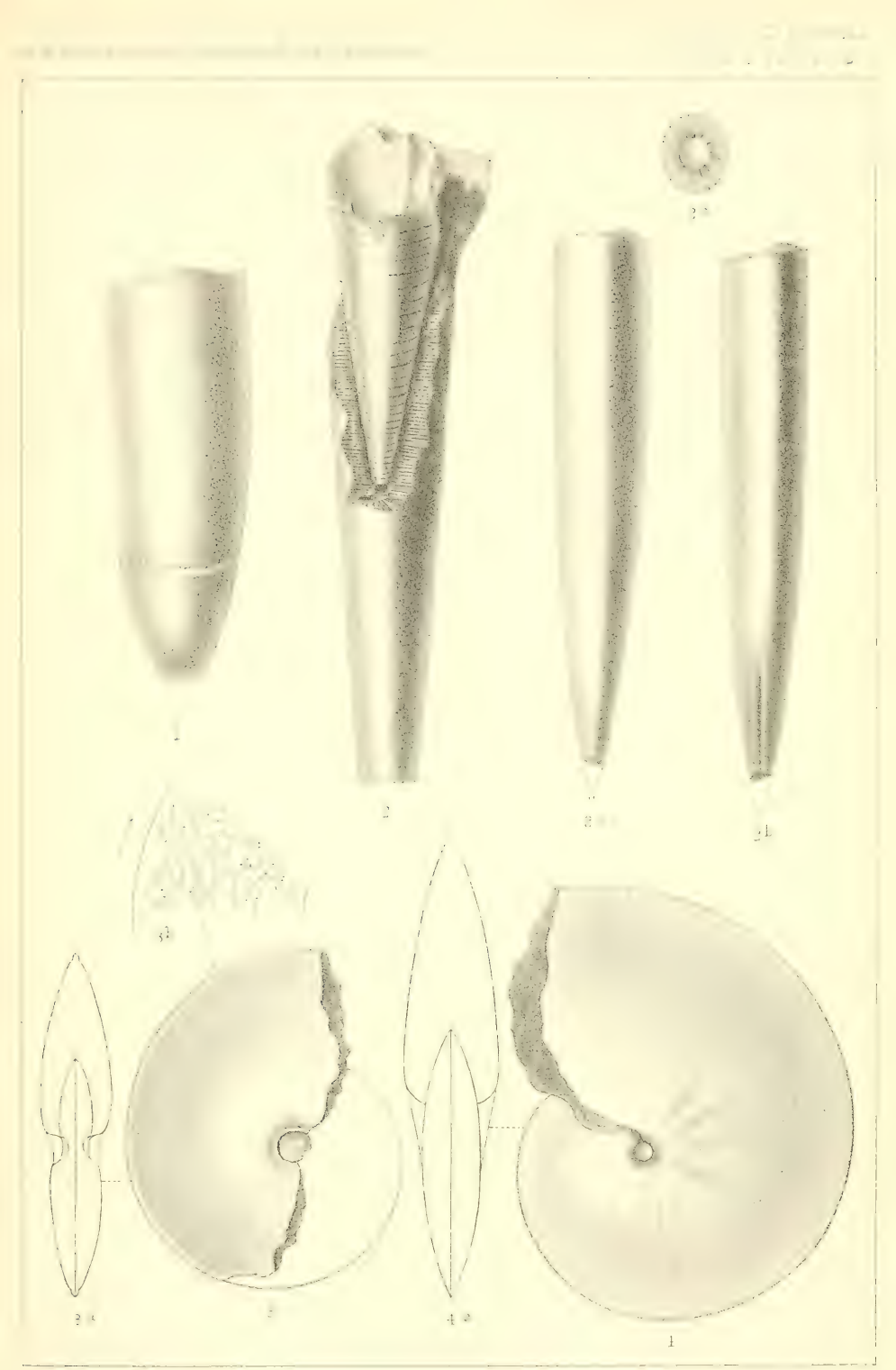

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PLATE XXIII.

OLCOSTEPHANUS LOGANIANUS (page 211).

Figure 1. Side view of the most perfect specimen known, from Sigutlat Lake, B.C.

" 1 *a*. Portion of a shell of the same species, from the south side of Alliford Bay.

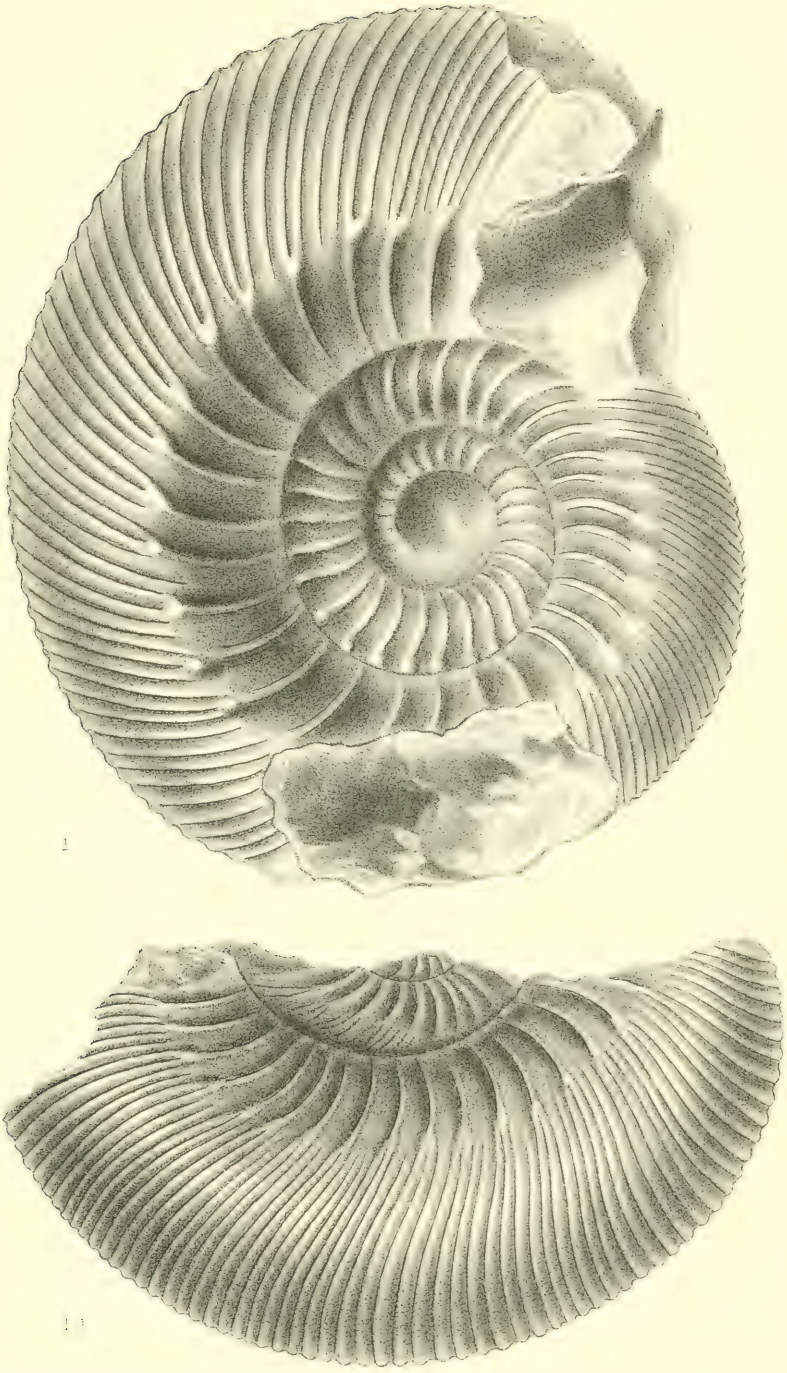


PLATE XXIV.

HAPLOCERAS CUMSHEWAENSE (page 208).

Figure 1. Side view of the type specimen from Cumshewa Inlet.

HAMITES (?) GLABER (page 213).

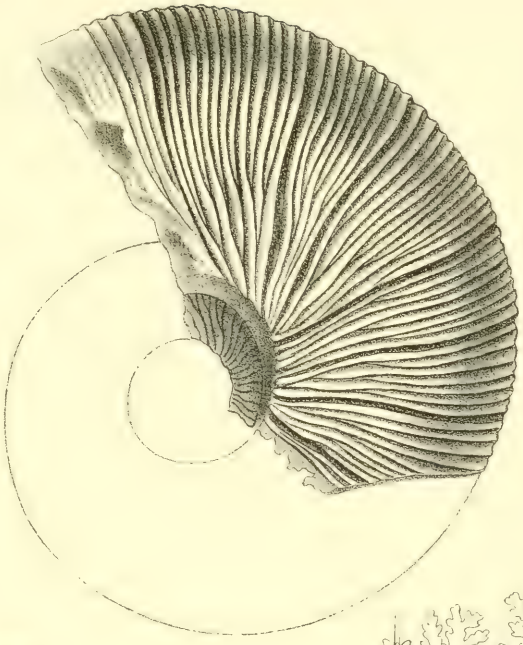
Figure 2. Portion of one of the limbs of this species, which shows two distant oblique constrictions.

" 2 *a*. Another portion of one of the limbs, with only one constriction.

" 2 *c*. Portion of a septum of the same.

" 2 *b*. Specimen showing portions of two of the limbs, one of which is bent closely on the other.

All the specimens figured are from Cumshewa Inlet.



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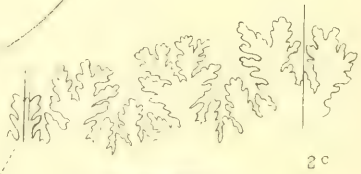

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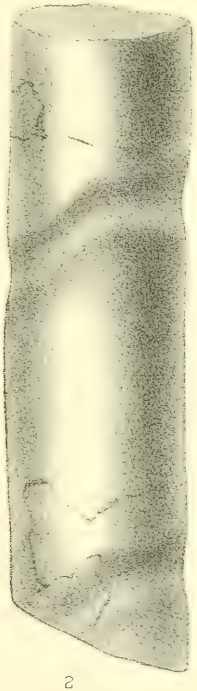

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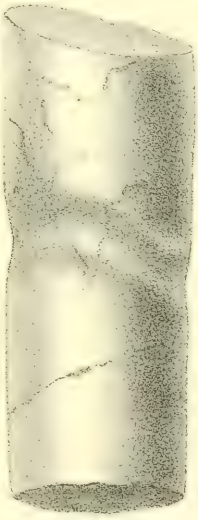

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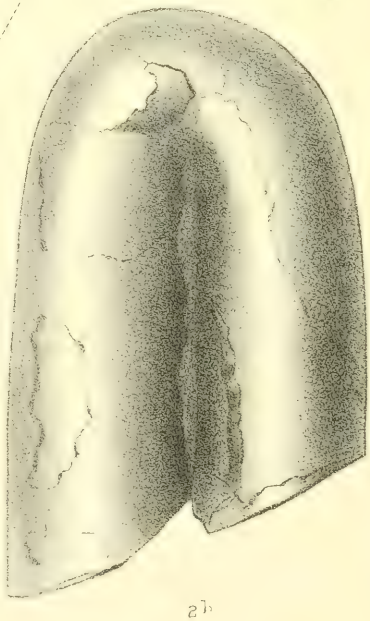

2b

PLATE XXV.

Lytoceras Sacya, Forbes, (page 203).

Side view of one of the best specimens collected by Dr. G. M. Dawson, from Bear Skin Bay, Skidegate Inlet.

PLATE XXVI.

HAPLOCERAS BEUDANTI, Brongniart, (page 205).

Figure 1. Side view of a specimen from Cumshewa Inlet, with the umbilical margin broadly rounded.

" 1 *a*. Portion of a septum of the same.

1a

M.Lambert del.

G.E.Desbarats & Co Lith.

PLATE XXVII.

Lytoceras Batesi, Trask, (page 202).

Figure 1. Side view of a specimen from Bear Skin Bay.

Nerinæa Maudensis (page 214).

Figure 2. A large but imperfect specimen.

" 2 *a*. Magnified view of a portion of the same.

" 2 *b*. A young but very perfect individual.

" 5 *c*. Another immature specimen whose apex is broken off.

" 2 *d*. View of a polished longitudinal section of another specimen to show the characters of the interior of the shell.

All the specimens figured are from the east end of Maud Island.

Cerithium Skidegatense (page 215).

Figure 3. Dorsal view of a specimen from the east end of Maud Island slightly enlarged.

" 3 *a*. Magnified view of the last whorl but one of the same, to show the details of the sculpture.

Vanikoro pulchella (page 215).

Figure 4. Dorsal view of the type specimen from the east end of Maud Island, enlarged about two diameters.

" 4 *a*. Ventral view of the same. to show the aperture and imperforate base.

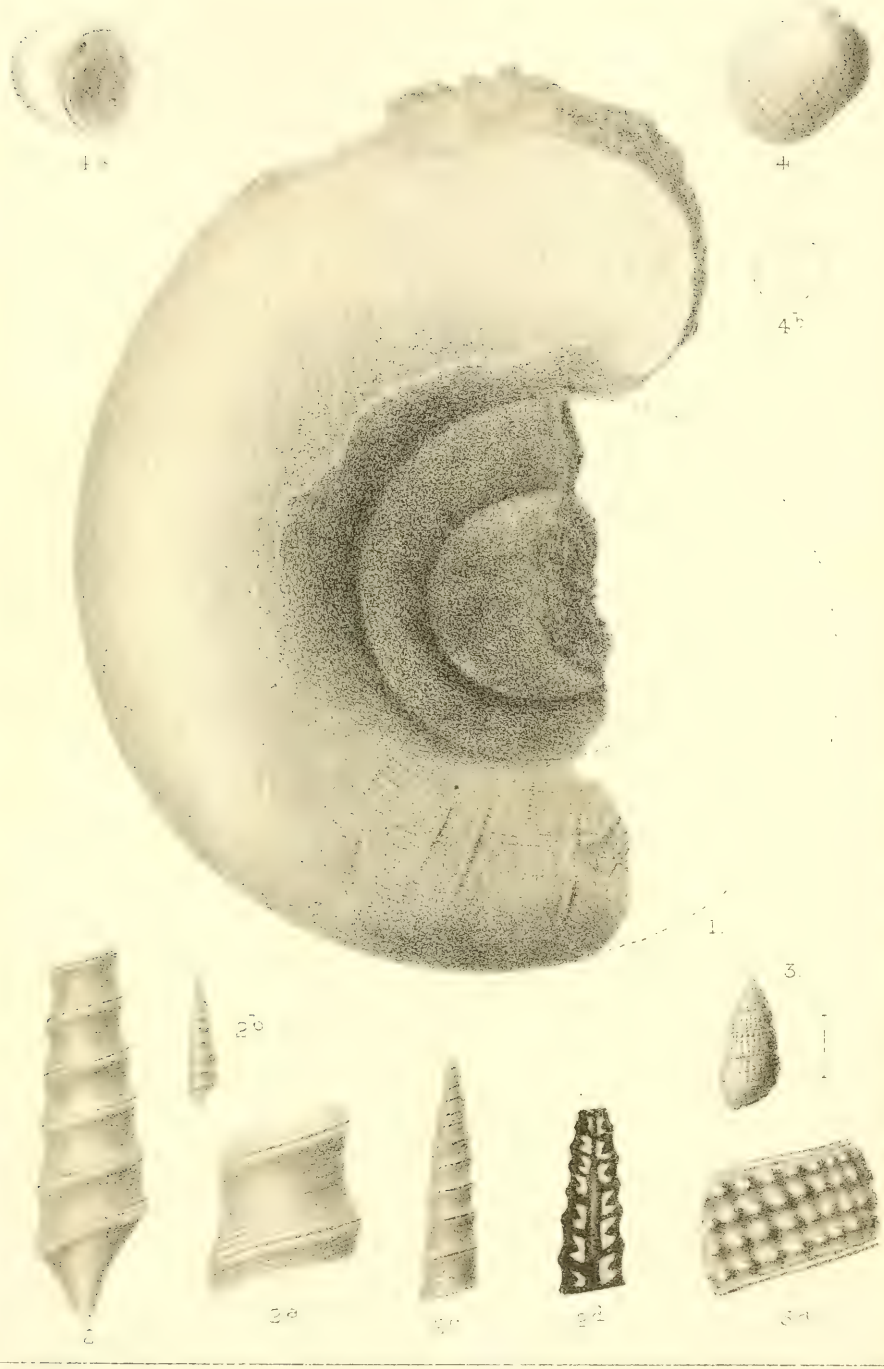
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PLATE XXVIII.

HAPLOCERAS PLANULATUM, Sowerby, (page 207).

Figure 1. Side view of a small specimen from Cumshewa Inlet.

ANCYLOCERAS RÉMONDI, Gabb, (page 212).

Figure 2. Side view of a specimen from Cumshewa Inlet.
" 2 *a*. Outline of a transverse section of the same.

AMAUROPSIS TENUISTRIATA, Whiteaves, (page 216).

Figure 3. Dorsal view of a specimen from Bay east of Alliford Bay.

CALLIOSTOMA CONSTRICTUM (page 217).

Figure 4. Dorsal view of the type specimen from the east end of Maud Island.
" 4 *a*. Another view of the same to show the imperforate base and shape of the aperture.

CINULIA PUSILLA (page 217).

Figure 5. Magnified view of an adult specimen from South Island.
" 5 *a*. Portion of surface of body-whorl of the same still further enlarged, to show the sculpture.

TROCHACTÆON CYLINDRACEUS, Stoliczka, (page 218).

Figure 6. Dorsal view of an average specimen, from Maud Island.

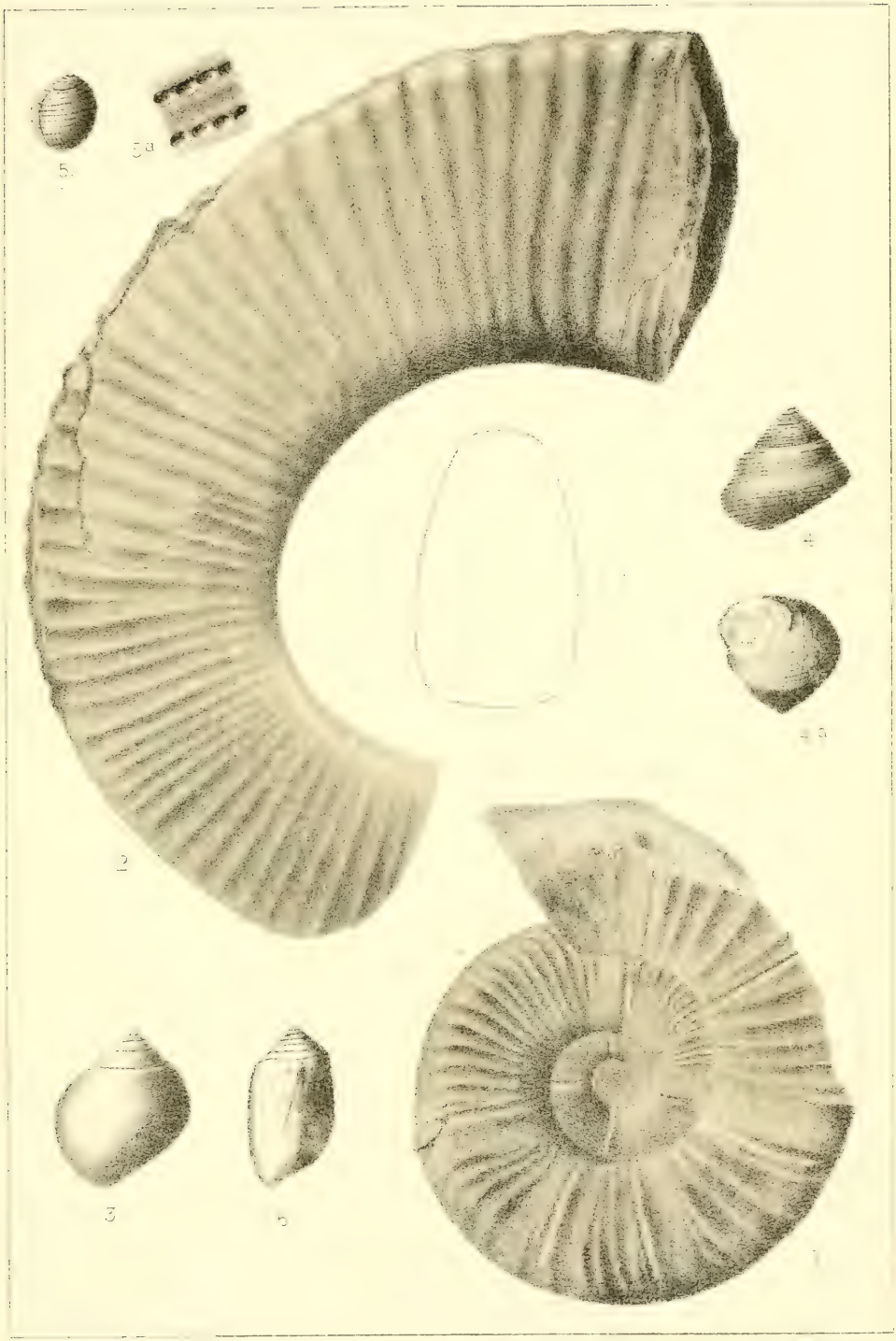
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PLATE XXIX.

Teredo Suciensis (page 218).

Figure 1. Side view of a left valve from Cumshewa Inlet, somewhat enlarged.

Martesia carinifera (page 219).

Figure 2. A nearly perfect cast of the interior of this shell, from Bear Skin Bay in Skidegate Inlet.

" 2 *a*. Portion of a mass of the burrows of this species, from the same locality as the last.

Corbula concinna (page 219).

Figure 3. Exterior of a right valve from the south side of Alliford Bay, considerably magnified.

" 3 *a*. Left valve of the same specimen, also enlarged.

Periploma cuspidatum (page 220).

Figure 4. View of a specimen from the north side of Maud Island, in which both valves are flattened out.

" 4 *a*. Right valve of another individual from the north side of Maud Island.

" 4 *b*. Left valve of a third specimen from the same locality,

Thracia semiplanata (page 221).

Figure 5. Exterior of a right valve from the south side of Alliford Bay.

" 5 *a*. " " left " " " "

" 5 *b*. " " another right valve from the south side of Alliford Bay.

" 5 *c*. Left valve of the same.

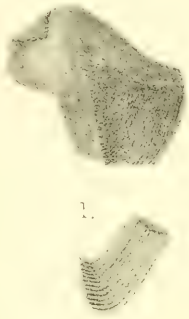
Pleuromya subcompressa, typical form, (page 222).

Figure 6. A small right valve from the south side of Alliford Bay.

Pleuromya subcompressa, var. Carlottensis, (page 223).

Figure 7. Side view of an imperfect specimen from the south side of Alliford Bay, showing part of the left valve.

" 7 *a*. Side view of another specimen from the same locality, showing most of the right valve.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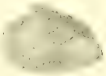
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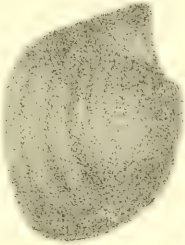
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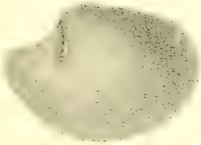
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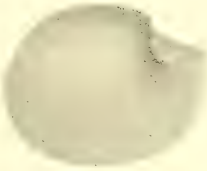
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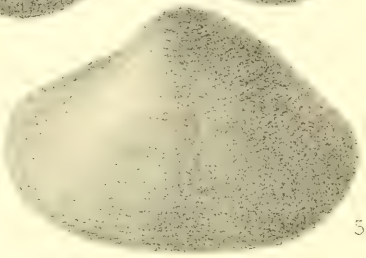
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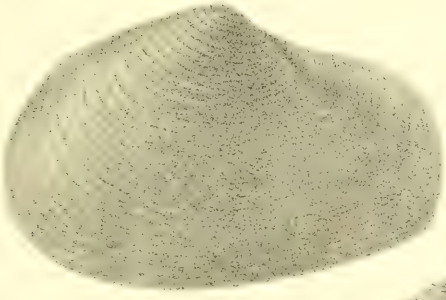
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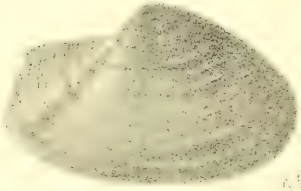
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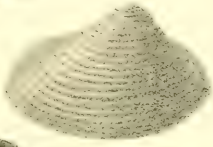
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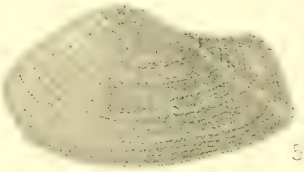
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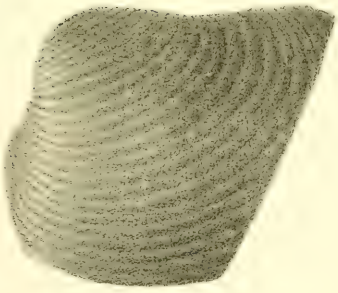
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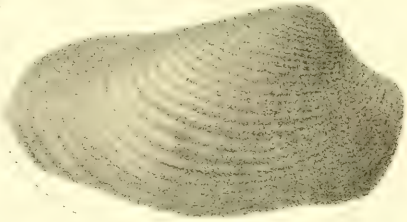

7a

PLATE XXX.

Pleuromya (subcompressa ? var.) lævigata (page 224).

Figure 1. Side view of a perfect specimen from the south side of Alliford Bay, showing the right valve.

" 1 *a*. The same aspect of another and equally perfect cast from Alliford Bay.

" 1 *c*. Do.

" 1 *b*. Dorsal view of the same specimen as the last, to show the thickness through the valves.

Tellina Skidegatensis (page 225).

Figure 2. A left valve which has the whole of the test preserved.

" 2 *a*. Right valve of a cast of the interior of the shell, which shews the muscular impressions and pallial sinus.

" 2 *b*. Side view of another left valve.

All the specimens figured are from Bear Skin Bay, in Skidegate Inlet.

Figure 3. Right valve of a shell from the north side of Maud Island, which may possibly belong to this species.

Thetis affinis (page 226).

Figure 4. View of a perfect cast of the interior of a shell of this species, from Bear Skin Bay, showing the strong double inflection of the pallial line.

" 4 *a*. The same, as seen from above.

" 4 *b*. Cast of a left valve of an ovately subtrigonal specimen, also from Bear Skin Bay.

Protocardium Hillanum, Sowerby, (page 228).

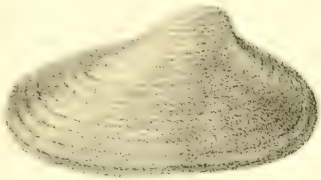
Figure 5. Right valve of a small specimen from the east end of Maud Island, which is supposed to be referable to this species. Slightly enlarged.

Astarte Packardi, White, (page 229).

Figure 6. Right valve, of large size, from the east side of Alliford Bay.

" 6 *a*. Interior of the same.

" 6 *b*. A smaller specimen from the same locality.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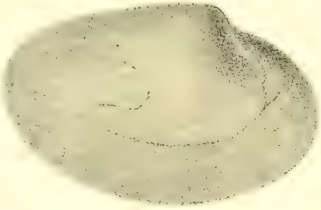
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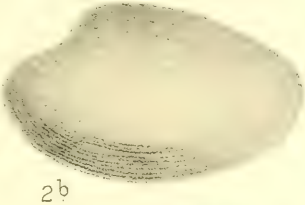
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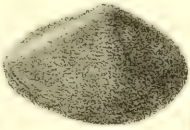
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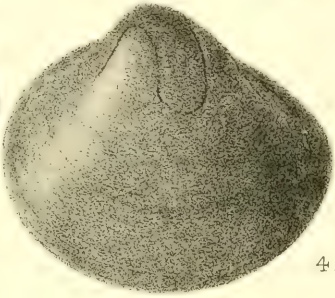
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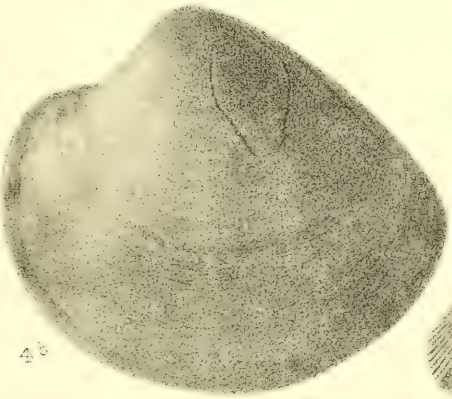
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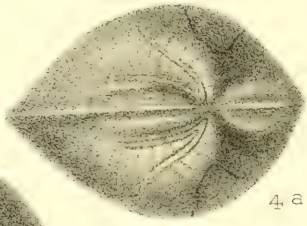
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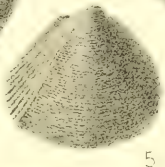
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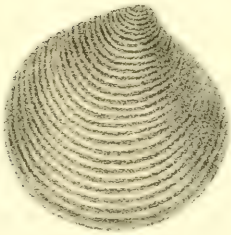
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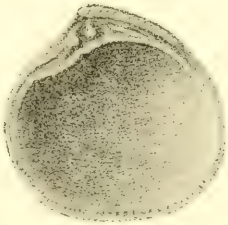
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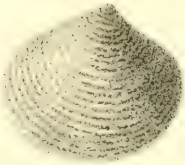


PLATE XXXI.

Trigonia Dawsoni, Whiteaves, (page 231).

Figure 1. Left valve of a specimen from the Iltasyouco River, B.C.

" 1 *a*. Right valve of a specimen from the south side of Alliford Bay.

Note.—This species, as stated on page 261, appears to be synonymous with *Trigonia intermedia*, Fahrenkohl.

Trigonia Maudensis (page 230).

Figure 2. Side view of a right valve of the most perfect specimen collected by Dr. G. M. Dawson, from the north side of Maud Island.

Nucula solitaria, Gabb, (page 232).

Figure 3. Side view of a cast of the interior with a small portion of the test remaining, slightly enlarged. From the south side of Alliford Bay.

" 3 *a*. Outline of the same specimen as viewed in front.

Yoldia arata (page 233).

Figure 4. Lateral view of a specimen from South Island, somewhat enlarged, and showing the right valve.

" 4 *a*. Another individual, from the same locality, in which the posterior extremity is more narrowly cuspidate.

Nemodon Fischeri, d'Orbigny, (page 234).

Figure 5. Side view of a perfect left valve from the east end of Maud Island.

Trigonoarca tumida (page 235).

Figure 6. A perfect right valve of this species from the east end of Maud Island.

Mytilus lanceolatus, J. Sowerby, (page 236).

Figure 7. Lateral view of a cast of the interior, from Shingle Bay, showing the left valve.

Outline of the base of the same specimen.

Grammatodon inornatus, Meek & Hayden, (page 235).

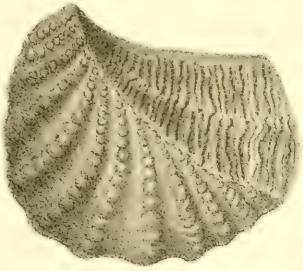
Figure 8. Side view of a specimen from Cushewa Inlet.

" 8 *a*. " " " the south side of Alliford Bay, in Skidegate Inlet.

" 8 *b*. Do.

Oxytoma mucronata, Meek, (page 238).

Figure 9. A left valve from the east side of Alliford Bay.



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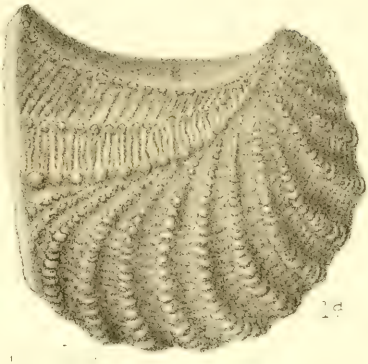

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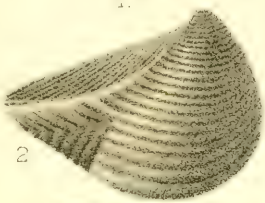

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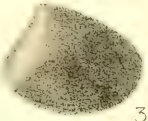

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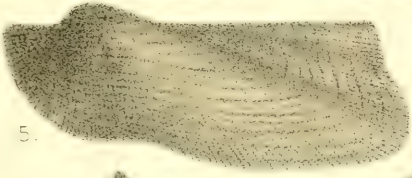

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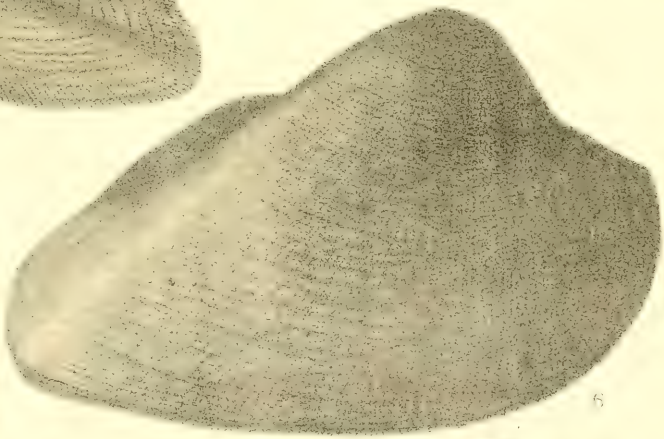

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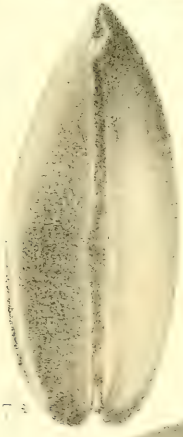

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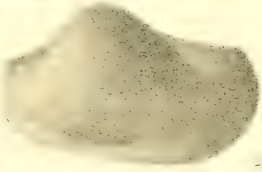

5b

PLATE XXXII.

Ostrea Skidegatensis (page 243).

Figure 1. A clustered specimen from the south side of Alliford Bay, as viewed from above.

Gryphæa Nebrascensis, Meek & Hayden, (page 244).

Figure 2. Specimen from the south end of Alliford Bay.

" 2 *a*. Another view of the same, to show the smaller and flatter valve.

" 2 *b*. " " " " amount of the convexity of the convex valve and its strongly incurved beak.

Inoceramus (Actinoceramus) sulcatus, Parkinson, (page 241).

Figure 3. Side view of a specimen from Bear Skin Bay Skidegate Inlet, showing the right valve and part of the left.

" 3 *a*. Another view of the same specimen, showing the left valve only.

Camptonectes curvatus, Geinitz, (page 242).

Figure 4. A right or under valve, from the east end of Maud Island.

Amusium lenticulare (page 242).

Figure 5. An upper valve from Cumshewa Inlet with both ears well preserved. A portion of the sculpture, magnified, is represented on the right hand side of the lower part of the figure.

Lithodomus Maudensis (page 237).

Figure 6. Side view of a specimen from the east end of Maud Island, somewhat enlarged.

" 6 *a*. Another view of the same, to show the amount of convexity of the closed valves.

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The present or fourth part of the first volume of "Mesozoic Fossils" is essentially an illustrated report on two collections of fossils from the Cretaceous rocks of the Queen Charlotte Islands, made by Dr. C. F. Newcombe, of Victoria, B.C., in 1895 and 1897. In addition to this, it contains a revision of the nomenclature of some of the fossils previously collected from these rocks by Mr. James Richardson in 1872 and by myself in 1878, and ends with a list of all the species that are now known to occur in them.

GEORGE M. DAWSON.

Geological Survey Office,
Ottawa, November 8, 1900.

MESOZOIC FOSSILS.

10,039

BY J. F. WHITEAVES.

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VOLUME I.

IV. On some additional or imperfectly understood fossils from the Cretaceous rocks of the Queen Charlotte Islands, with a revised list of the species from these rocks.

Prefatory Remarks.

In 1895 and 1897, extensive collections of fossils from the "Lower Shales", or "Division C", of the coal-bearing rocks of the Cretaceous system, at Skidegate and Cumshewa inlets, were made by Dr. C. F. Newcombe, of Victoria, V.I. A full series of the choicest specimens in these collections has been lent to the writer for study and comparison, and some of the best of them have been generously presented by Dr. Newcombe to the Museum of the Survey. Those which the writer has seen add eight new species of marine invertebrata (viz., three of ammonitidæ, four of pelecypoda, and one of brachiopoda) which are described and figured in this paper, to the fauna of the Lower Shales, besides some interesting fossil plants, which have yet to be studied. Some of the fossils collected by Dr. Newcombe, also, are much better specimens than had previously been obtained of species that had already been described. Thus, one particularly fine specimen (which has been presented to the Museum) shows that the fragments upon which *Spiroceras Carlottense* was based (in the third part of this volume) are portions of a large *Turrilites*; and others that *Acanthoceras spiniferum* is probably distinct from *A. Stoliczkanum* (Gabb).

The revised list of species at the end of this paper shows that eighty-nine species of marine invertebrata are now known from the Lower Shales besides five that are too imperfect to be determined specifically. Of the

former one is a coral, three are brachiopods, one is a crustacean, and the rest are mollusca proper. The cephalopoda are much more numerous, both in species and in individuals, than the gasteropoda, and the ammonitidæ are specially abundant. The latter would seem to be remarkable for the presence of several species of *Desmoceras* (inclusive of *Puzozia)*, and for the absence of *Baculites*, and of the numerous species of *Pachydiscus* which are so characteristic of the Vancouver Cretaceous. The number of species of pelecypoda appears to be much larger, even, than that of the cephalopoda. No new information has been obtained about the fossils of Subdivisions A, B, D, or E, of Dr. G. M. Dawson's section.

The progress of palæontological research during the fourteen years that have elapsed since the third part of this volume was written, has necessitated some alterations in the nomenclature of the genera and species described or identified therein. Thus, on page 205 of that part, an Ammonite which is very abundant at Cumshewa Inlet was identified with the *Ammonites Beudanti* of d'Orbigny and Stoliczka,—and placed in the genus *Haploceras* on the authority of Dr. Neumayr, in his paper "Ueber Kreideammonitiden" in the Transactions of the Royal Academy of Sciences of Vienna for 1875. Since then, however, Zittel has placed *A. Beudanti* in his genus *Desmoceras*, and still more recently, Dr. Franz Kossmat (who refers it to *Puzozia*, which he regards as a subgenus of *Desmoceras*) claims that several species have been confounded under the name *Ammonites Beudanti*, and that the Cumshewa specimens are not exactly like any of them.. It has therefore seemed most prudent to distinguish the Cumshewa *Desmoceras* (or *Puzozia*) by a different specific name.

On page 234 of the same part, specimens of an *Arca*-like shell from Maud Island are designated "*Nemodon Fischeri*, d'Orbigny, (Sp.)". Their hinge dentition was supposed to be like that of Conrad's genus *Nemodon*, and their specific identification was based partly on their great similarity to d'Orbigny's figures of *Arca concinna* (a name that was found to be preoccupied and changed to *A. Fischeri*); and partly on the fact that Eichwald held that the beds holding *Arca Fischeri* and *Aucella Mosquensis* are of Neocomian rather than of Jurassic age. In the most recent Russian geological publications, however, these beds are regarded as "Oxfordien", and the identification of the Maud Island *Arca* with a Russian Jurassic species would seem to be no longer tenable.

Among the Ammonites from the "Lower Shales", collected by Mr. Richardson in 1872, there are a few species that seemed to have such a Jurassic aspect, that three of them were referred to the Jurassic genus *Stephanoceras*, and two to *Perisphinctes*, which is almost exclusively Jurassic. But, in the present state of our knowledge of the Cretaceous Ammonitidæ, these resemblances would seem to be more apparent than

real. At any rate, Dr. Kossmat (on page 27 (134) of the second part of his monograph of the Cretaceous Cephalopoda of Southern India) has expressed the opinion that *Ammonites Richardsoni* (nobis) is an *Olcostephanus* rather than a *Stephanoceras*. Numerous specimens collected by Dr. Newcombe show that "*Stephanoceras cepoides*" (and probably *S. cblatum*) is an *Olcostephanus*, with much the appearance of a Scaphite. Dr. Kossmat, too, in a letter to the writer, says that he thinks that *Ammonites Skidegatensis* and *A. Carlottensis* (which the writer had referred to *Perisphinctes*) may possibly be referable to *Olcostephanus*, and perhaps most nearly related to a Mexican Cretaceous species (*O. Zirkeli*) recently described by Felix and Lenk.*

In the present paper, also, it has been thought desirable to distinguish by different, and for the most part new, specific names, a few fossils from the Lower Shales that have previously been identified with the following Jurassic species from the western United States.†

Belemnites densus, Meek & Hayden.
Pleuromya subcompressa, Meek.
Grammatodon inornatus, Meek & Hayden.
Modiola subimbricata, Meek.
Oxytoma mucronata, Meek.
Gryphæa Nebrascensis, Meek & Hayden.

It has long been obvious that the Lower Shales represent a well-defined horizon in the earlier Cretaceous of the Pacific coast of North America, and it now seems scarcely probable that any of the fossils therefrom can be identical with any of these species. In any case, Dr. Stanton states that the name *Pteria* (or *Oxytoma*) *mucronata*, Meek, is preoccupied; and additional specimens of the *Modiola* from Maud Island, collected by Dr. Newcombe in 1895, show that it is probably distinct from *M. subimbricata*.

Plate 33, which refers exclusively to specimens described or referred to on pages 246-252 of Part III, and which should have accompanied it, is issued herewith.

In conclusion, the writer desires to express his thanks to the following gentlemen for assistance rendered during the preparation of this paper. To Dr. C. F. Newcombe, and to Mr. John Fannin, Curator of the Provincial Museum at Victoria, for the loan of many interesting specimens. To Professor H. Pilsbry, for the loan (for comparison) of the types of *Pleuromya papyracea*, *Meekia sella*, and *Cucullæa truncata*, Gabb, from the Museum of the Academy of Natural Science of Philadel-

*Beiträge zur Geologie und Palæontologie der Republik Mexico, theil 3, p. 182, pl. 29.

†The specimens referred to *Astarte Packardi*, on page 229 of this volume, have since been described as *A. Carlottensis*, on page 154, of volume 1, pt. 2, of "Contributions to Canadian Palæontology," published in 1889.

phia. To Dr. T. W. Stanton, for the opportunity of examining Californian specimens of the three species of *Meekia* described by Gabb. To Professor J. C. Merriam, for kindly comparing four specimens from Skidegate Inlet with the types of *Terebratella obesa*, Gabb, in the Museum of the University of California, at Berkeley; and to Dr. Franz Kossmat, for critical suggestions in reference to *Acanthoceras spiniferum*.

Notes on the Species from the Lower Shales, with descriptions of a few that appear to be new.

FISHES.

Teleostei.

The only remains of fishes from the Cretaceous rocks of the Queen Charlotte Islands that the writer has seen are a few well-preserved but imperfect scales, collected at South Island, in Skidegate Inlet, by Dr. G. M. Dawson, in 1878. The largest of these are about ten or eleven millimetres in their maximum diameter. They are very thin, cycloidal, rather variable in outline, but mostly subquadrate, with an eccentric nucleus. Their sculpture consists of extremely minute and densely crowded concentric raised lines, and of larger and more distant radiating ones inclosed in a triangular area.

CRUSTACEA.

Decapoda.

"Genus Homolopsis, Bell.

"Carapace longer than broad, quadrilateral; regions of carapace very distant; branchial region large, triangular; orbits close together, frontal region rather produced; front subrotund." Woodward.

Homolopsis Richardsoni, Woodward.

Homolopsis Richardsoni, Woodward. 1896. Quart. Journ. Geol. Soc. Lond., vol. lii., p. 224, fig. 3.

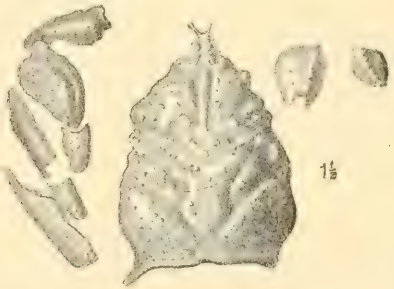

Fig. 13. *Homolopsis Richardsoni*. From a cliché of the original block, kindly supplied by Dr. Woodward.

"This interesting little crab was obtained by Mr. James Richardson in 1872 from Skidegate Inlet, west of Alliford Bay, Queen Charlotte Islands, and is preserved in a hard black limestone-nodule containing plant-remains. Portions of the limbs still remain in their normal position, showing that it was entire when originally buried in the matrix.

"Length of carapace 20 millim., greatest breadth 17 millim.; breadth of posterior border 14 millim.; breadth across hepatic region 14 millim.

"The carapace is broadly quadrilateral, but pointed in front; the branchial regions extend to fully one half the length of the carapace; they are roughly triangular in shape, and nearly meet on the middle line behind the cardiac region; cardiac region small, shield-shaped but elevated; metagastric region marked by two small prominences; hepatic regions prominent. Two very distinct and almost parallel furrows, the branchial furrow and cervical or hepatic furrow, diverge from the sides of the cardiac and metagastric regions obliquely forward towards the lateral margins of the carapace. Two deep submedian furrows mark the frontal portion of the cephalothorax; reaching to the rostrum, where they converge on the central line. Two small spines (or other appendages) project (as in the genus *Latreillia*) from the rostrum on either side.

"The hinder border is extremely wide and straight, and suggests the broad margin for the attachment of the tail as in the females of all the Anomala, in which section the abdomen is only partially concealed beneath the cephalothorax.

"The surface of the carapace, which is tumid, is coarsely and irregularly covered with small rounded tubercles, which are larger on the gastric and hepatic regions.

"The walking legs were evidently long and fairly large, and the chelipeds covered and tuberculated as in *Homola*.

"This species has many points of resemblance to Reuss's *Prosopon verrucosum*, from which, however, it differs in the greater anterior breadth of Reuss's specimen, and in the form of the rostrum and arrangement of the furrows upon the gastric and cardiac regions. Reuss's *P. verrucosum* should probably be placed in Bell's genus *Homolopsis*.

"In *Homolopsis Edwardsii*, Bell, from the Gault of Folkestone, the frontal border is broader and the carapace more quadrate than in the North American form, which is pointed in front; the anterior half of the carapace in *H. Edwardsii* is more coarsely ornamented with fewer and larger tubercules, and the arrangement of the lobes differs considerably from that in *H. Richardsoni*.

"I would refer this specimen to *Homolopsis*, and dedicate this species to the discoverer, Mr. James Richardson.

"The specimen is from the Museum of the Geological Survey of Canada, Ottawa."—Woodward.

With the exception of *Unio Hubbardi*, and possibly of some of the plants, all the fossils from the "Lower Shales" in Skidegate Inlet, collected by Mr. Richardson, are labelled "west of Alliford Bay." The writer was informed by Mr. Richardson that all the specimens thus labelled are from Maud Island, or Lina Island, but mostly from the former.

MOLLUSCA.

Cephalopoda.

(Dibranchiata.)

Phylloteuthis incertus. (Nom. prov.)

Plate 35, fig. 1.

Expanded part of the gladius of the only specimen known to the writer resembling that of the type of *P. subovata* of Meek and Hayden, as described and figured by Meek,* in some particulars, but differing apparently therefrom in its larger size, much greater proportionate breadth anteriorly, and broader midrib. Oblique striæ of the alation much as in *P. subovata*. Shaft unknown.

East end of Maud Island, Dr. G. M. Dawson, 1878 : an impression of the greater part of the expanded portion of the gladius, which, however, is very imperfect at both ends and nowhere shows the exact marginal outline. Its actual dimensions are, length about forty-five millimetres, breadth about thirty-four, whereas in Meek's type of *P. subovata*, which shows a considerable portion of the marginal outline, the length of the organism, apart from the restoration, is thirty-nine mm., and the greatest breadth only twenty-one and a half.

Belemnites assimilis. (N. Sp.)

Belemnites, (Sp. undt.) Whiteaves. 1876. This volume, pt. 1, p. 11, fig. 1, and pl. 1. figs. 1, 1, *a-c*.

Belemnites densus, Whiteaves. 1884. Ibid., pt. 3, p. 194, pl. 22, fig. 1. But possibly not *B. densus*, Meek and Hayden (1858); which is said to be a Jurassic species.

Skidegate Channel, west of Alliford Bay, J. Richardson, 1872 ; and coal locality, south side of Skidegate Inlet, Dr. G. M. Dawson, 1878 ; the specimens referred to on pages 11 and 194 of previous parts of this volume.

*Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country, p. 505, pl. 33, fig. 3.

Belemnites Skidegatensis.

Belemnites Skidegatensis, Whiteaves. 1884. This volume, pt. 3, p. 195, pl. 22, figs. 2 and 2, *a–c*.

An unusually good specimen of the guard of this species was collected on the south side of Alliford Bay, in Skidegate Inlet, by Dr. Newcombe in September, 1895.

(Tetrabranchiata.)

Nautiloidea.

Nautilus (Cymatoceras) Carlottensis. (N. Sp.)

Nautilus (Sp. undt.) Whiteaves. 1876. This volume, pt. 1, p. 14.

Nautilus Suciensis, Whiteaves. 1884. Ibid., pp. 33, 197 and 198, pl. 21. But perhaps not *N. Suciensis*, Whiteaves, 1879; ibid., pt. II, p. 97, pl. 11, figs. 1 and 1 *a*.

Maple Island, Skidegate Inlet, C. F. Newcombe, 1895: a cast of the body chamber some seven inches in length, by about four inches and a half in its maximum breadth, with a faint longitudinal depression or shallow groove in the middle of the venter.

The identification of the large ribbed *Nautilus* from the Lower Shales at Skidegate Inlet with the *N. Suciensis* of the Nanaimo group of the Sucia Islands has not proved quite satisfactory, and it is now thought desirable to distinguish the former provisionally by a different specific name.

Ammonoidea.

Phylloceras Knoxvillense. Var.

Cfr. *Phylloceras Knoxvillensis*, Stanton. 1896*.—Bull. U. S. Geol. Surv., No. 133, p. 72, pl. 14, figs. 1-4.

Shell essentially similar to *P. Knoxvillense*, in shape, surface markings and septation, and differing therefrom only in the entire absence of any "well marked periodic constrictions."

East end of Maud island, C. F. Newcombe, 1895: two specimens, the larger (which has been presented to the Museum) 102 mm., or about four inches, in its maximum diameter; the smaller 67 mm., or nearly two inches and three-quarters. These specimens are intermediate in their characters between the typical form of *P. Knoxvillense* and *P. ramosum*, Meek, which latter shell is regarded by Dr. Kossmat as identi-

* Although the date on the cover and title pages is 1895, the words "Issued Feb. 3, 1896" are written on the outside of a copy sent to the writer by Dr. Stanton.

cal with *P. Nera*, the *Ammonites Nera* of Forbes. The smaller one differs from *P. ramosum* only in having slightly coarser ribs.

Cumshewa Inlet, C. F. Newcombe, 1897 : two very imperfect specimens, which may be referable to this species, but which seem to have a rather wider umbilicus in proportion to the size of the shell.

Lytoceras Batesi, Trask. (Sp.)

Ammonites Batesii, Trask. —1855. Proc. Calif. Acad. Sc., vol. I, p. 40.
" " Gabb. —1864. Geol. Surv. Calif., Palæont., vol. I, p. 67, pl. 13, figs. 16 and 16, *a-b*.
" " Gabb. —1869. Ibid., vol. II, p. 132, pl. 20, fig. 9 *a*, and pl. 21, figs. 10, *a-b*.
Ammonites crenocostatus, Whiteaves. —1876. This volume, pt. 1, p. 45, pl. 9, figs. 2 and 2 *a*.
Lytoceras Batesi, Whiteaves. —1884. Ibid., pt. 3, p. 202, pl. 27, fig. 1.
" " Stanton. —1896. Bull. U.S. Geol. Surv., No. 133, p. 75, pl. 13, figs. 9-11.

East end of Maud Island, Dr. C. F. Newcombe, September, 1895 : three small specimens. Lina Island, Skidegate Inlet, Dr. Newcombe 1897 : a specimen (now in the Museum of the Survey) about two inches and three-quarters in its maximum diameter. According to Dr. Kossmat, (Mittheil. Paläont. Inst. Univ. Wien, Band IX, p. 113) this species is a typical *Lytoceras* and belongs to the group of *L. fimbriatum* (Sowerby.)

Lytoceras (Gaudryceras) Sacya, Forbes (Sp.)

Ammonites Sacya, Forbes. 1846. Trans. Geol. Soc. London, Ser. 2, vol. VII, p. 113, pl. 14, fig. 10.

Ammonites Buddha, Forbes. 1846. Ibid., vol. VII, p. 112, pl. 14, fig. 9.

Ammonites Sacya, Stoliczka. 1865. Palæontologia Indica, Cret. Fauna S. India, p. 154, pl. 75, figs. 5-7 ; and pl. 76, figs. 2 and 3.

Ammonites Sacya, var. *Sachalinensis* (in part). Fr. Schmidt. 1873. Kreidepetrefacten von Sachalin (Mém. Acad. St. Petersbourg, VII Ser., Tome XIX, No. 3) p. 15, pl. 2, figs. 3 and 4.

Ammonites filicinctus, Whiteaves. 1876. This volume, pt. 1, p. 43, pl. 2, figs. 2, 2 *a-c*, and 3.

Lytoceras Sacya, Whiteaves. 1884. Ibid., pt. 3, p. 203, pl. 25.

" " M. Yokoyama. 1889. Versteinerungen aus der Japanischen Kreide (Palæontographica, vol. XXXVI) p. 178, pl. 18, figs. 12 and 13.

" " K. Jimbo. 1894. Fauna der Kreide von Hokkaido (Palæontol Abhandlungen, vol. VI, pt. 3) p. 34 (180), pl. 6 (22), fig. 1.

" " Stanton. 1894. Stanton and Diller. The Shasta-Chico Series Bull. Geol. Soc. America, vol. V, p. 445.

Lytoceras (*Gaudryceras*) *Sacya*. Kossmat. 1895. Untersuchungen über die Südindische Kreideformation, (Mittheil. Paläontolog. Instit. Universitat Wien," Band IX,) p. 119.

Maple Island, Skidegate Inlet, Dr. Newcombe, 1895: a distorted specimen, about five inches and a half in its greatest diameter. Cumshewa Inlet, Dr. Newcombe, 1895: one rather worn specimen. As *Ammonites Buddha* was first described by Forbes on page 112, and *A. Sacya* on page 113 of the same volume of Transactions of the Geological Society of London, it seems to the writer that the former of these two specific names should have been retained for this species.

Lytoceras (Tetragonites) Timotheanum, Mayor. (Sp.)

Ammonites Timotheanus, Mayor. 1847. Pictet and Roux, Mollusques des Grés Verts, p. 39, pl. 2, fig. 6; and pl. 3, figs. 1 and 2.*

" " Stoliczka. 1865. Palæontologia Indica, Cret. Cephal. S. India, p. 146, pl. 73, figs. 3–6.

" " Fr. Schmidt. 1873. Petref. der Kreide von Sachalin, p. 14, pl. 2, figs. 7–11.

" " Whiteaves. 1876. This volume, pt. 1, p. 41, pl. 3, figs. 2 and 2 *a*.

Lytoceras Timotheanum, Whiteaves. 1884. Ibid., pt. 3, p. 203.

Lytoceras (Tetragonites) Timotheanum, Kossmat. 1895. Untersuchungen Südindische Kreideformation, p. 133, pl. 17 (3), figs. 11, and 13, *a–b*.

East end of Maud Island, Dr. Newcombe, 1895: one specimen. An imperfect but well preserved and characteristic specimen in the Museum of the Survey, which is clearly referable to this species, was collected in the Cretaceous rocks at Comox, Vancouver Island, by Mr. Walter Harvey in 1891.

Turrilites Carlottensis, Whiteaves.

Plate 34 (the only figure).

Spiroceras Carlottense, Whiteaves. 1884. This volume, pt. 3, p. 198.

Amended description.—Shell large, narrowly elongated, usually sinistral, but apparently sometimes dextral: volutions widely separate longitudinally, slightly compressed on the venter and dorsum, broadly subovate or almost circular in transverse section, and coiled obliquely in such a way as to leave a rather wide empty space, of the nature of an umbilical perforation, in the middle of each. Surface markings consisting of small, close-set, low, transverse ribs, and of comparatively distant spines or tubercles. Sutural line not clearly shown in any of the specimens that the writer has seen, but the siphuncle forms the median line of the venter.

The smallest but much the most perfect of the three specimens of *Spiroceras Carlottense* from Cumshewa Inlet, described in the third part of this volume, must be regarded as the type of that species. It shows that the ribbing is rather faint, and that there are three spinous tuber-

cles in each transverse row, on the lower half of one of the early volutions, and apparently below the siphuncle. In the large specimen figured, which was recently collected by Dr. Newcombe, and is believed to be referable to this species, the ribs are small, rounded and closely disposed. The tubercles are badly preserved and obscurely indicated, but they appear to have been both large and distant. In each transverse row there are indications of four tubercles, three below the siphuncle and one above.

Skidegate Inlet, at Bearskin Bay, (the fine specimen figured, which is upwards of eight inches in length, and more than four inches in its maximum breadth,—and two fragments); and at Maple Island, a specimen consisting of one nearly complete volution. North side of Cumshewa Inlet, two fragments. All of these specimens were collected in September, 1895, by Dr. Newcombe, who has kindly presented the one figured to the Museum of the Survey.

As now understood, this species would seem to be a true *Turrilites*, rather than a *Spiroceras* or *Helicoceras*, although its volutions are far from being closely contiguous.

Turrilites. (Species uncertain.)

A worn specimen, consisting of rather more than two volutions, collected at Skidegate Inlet, by Dr. Newcombe, in 1897, though too badly preserved to admit of accurate identification or description, is yet clearly distinct from *T. Carlottense*. It differs therefrom very obviously in its closely and compactly coiled volutions, imperforate axis, and very coarse transverse ribs. The specimen is now in the Museum of the Survey.

Diptychoceras.

A specimen of nearly the whole of the outer limb of a species of *Diptychoceras*, that seems to differ from the *D. lævis* of Gabb in being marked by low, rounded, transverse and straight annulations, was collected at Cumshewa Inlet by Dr. Newcombe in 1895. The specimen is a little more than two inches and a half in length, nearly circular in section and about twelve millimetres, or not quite half an inch, in its dorso-ventral diameter, at or near the anterior end. Its sutural line is very similar to that of *D. lævis*.

Schloenbachia inflata, Sowerby. (Sp.)

Ammonites inflatus (Sowerby.)	—Stoliczka. 1865. Cret. Ceph. S. India, vol. I, p. 48, (which see for a list of the synonyms of European specimens), pls. 27, 28, 29; and 30, figs. 1-3.
Schloenbachia inflata, Whiteaves.	—1884. This volume, pt. 3, p. 200.
" " Szainocha.	—1885. Zur Kenntniss einer mittelcretatischen Cephalopoden fauna den Inseln Elobi. (Denkschr. d. k. Akad. d. Wissensch. Wien, Mat. nat. Cl. 1885, Bd. XLIX) p. 232, pl. 2, figs. 1-3.
" " Choffat.	—Matériaux pour l'étude stratigraphique et paléontologique de la province d'Angola, (Mem. Soc. de Physique et d'Histoire Naturelle de Genêve, vol. xxx, pt. 1, No. 2.) p. 62.
" " *var.* Jack & Etheridge.	—1892. Geol. and Palæont. of Queensland and New Guinea, London, p. 409.
" " Diller and Stanton.	—1894. Bul. Geol. Soc. Amer., vol. v, p. 445.
" " Kossmat.	—1895. Untersuch. über die Südindische Kreideformation, pt. 1, p. 185, pl. 23 (9) *a-c*, and 2; and pl. 24 (10), fig. 1.

East end of Maud Island, Dr. Newcombe, 1895: a large but imperfect specimen, about eight inches in its maximum diameter.

Acanthoceras spiniferum. (Nom. mut.)

Plate 35, figs. 2, and 3, 3 *a*.

Ammonites Stoliczkanus, var. *spiniferus*, Whiteaves. 1876. This volume, pt. 1, p. 24, fig. 2; pl. 3, fig. 3; and pl. 4, fig. 1.

In 1895, Dr. Newcombe collected several specimens of this species at the east end of Maud Island, and among them a particularly fine specimen, that is about eight inches in its maximum diameter and five inches in breadth. This fine fossil, which has been acquired for the Survey collection, gives a much better idea of the characters of the adult stage of *A. spiniferus* than the imperfect and distorted original of figure 1, on plate four of this volume, which was the largest specimen then known. The former may be briefly described as follows: Shell large, strongly inflated but deeply and rather widely umbilicated, the umbilicus occupying a little more than one-third of the total diameter. Volutions probably about five, though only the three outer ones are seen in this specimen, increasing rather rapidly in size, the outer one rounded, but a little broader laterally than in a ventro-dorsal direction, truncated on the umbilical side and overlapping about one-half of the previous one. Umbilicus steep-sided, with a rounded margin; shape of the outer lip unknown.

Surface marked by transverse, tuberculated ribs, which are usually simple but occasionally bifurcate. One comparatively large and long rib usually alternates with two smaller and shorter ribs, and each rib bears six small, distant tubercles on each side of the siphuncle. Septum, much as in *Acanthoceras mamillare* (Schlotheim).

An unusually perfect but very small specimen collected by Dr. Newcombe, a little over an inch in its maximum diameter, the original of figs. 3 and 3 *a* on Plate 35, has four tubercles on each rib, on each side of the siphuncle, arranged as follows: one small tubercle on the umbilical margin, one half-way across the side, and two tubercles close together, just outside of the siphuncle.

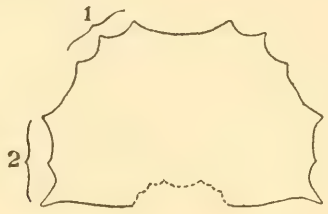

Fig. 14. *Acanthoceras spiniferum.* Outline of transverse section of a small specimen, to show the relative position of the two sets of tubercles on each side.

The following notes on the specific relations of *A. spiniferum* have been kindly communicated by Dr. Franz Kossmat, of the University of Vienna, to whom one of the medium-sized specimens collected by Dr. Newcombe was sent in March, 1896, for comparison with *A. laticlavium*, Sharpe, var. *Indicum*, Kossmat.

"*Acanthoceras Stoliczkanum*, var. *spiniferum*, Whiteaves.

"I have been quite surprised by the close resemblance of this species to our European *Acanthoceras mamillare* (Schlotheim), one of the most common fossils of the European Gault (Albien), known also in the Cretaceous deposits on the western coast of Africa. The specimen you have so kindly sent me is characterized by a very peculiar ornamentation, consisting of two sets of tubercles on each side.

"Each of these sets is composed of three tubercles, which are spirally elongated and sharpened in set 1, and rounded in set 2. The two sets of tubercles are separated from each other by a greater distance than the interstices between the tubercles in either set. On *A. mamillare* also, in middle stages of growth, there are two sets of tubercles on each side of the siphuncle, which arise from two tubercles only (in youth stage) by successive division, the same as you observed in *A. spiniferum*. The inner tubercles on the inner whorls are often somewhat spinous (Comp. P.

Choffat : Matériaux pour l'étude stratigraphique et paléontologique de la province d'Angola ; Mémoires de la société de physique et d'histoire naturelle de Genève, tome xxx, no. 2, 1888, pl. 3, fig. 1). Your specimen must be regarded as specifically distinct from *A. mamillare*, the siphonal interstice between the outer tubercles being broader, the number of tubercles in medium and comparatively large specimens smaller, etc., but it must certainly be considered as an American representative of the group of *A. mamillare*. You have already stated that it belongs to the *Mamillati*. Its general resemblance to *A. laticlavium* cannot be denied, but I think its relations to *A. mamillare* are even closer. *A. spiniferum* increases the number of Gault types in the Cretaceous series of the Queen Charlotte Islands, and strengthens your opinion that at least a part of the division C corresponds to the Gault."

On receipt of this communication, a photograph (natural size) of the large specimen collected by Dr. Newcombe was mailed to Dr. Kossmat who acknowledged its receipt in the following terms : "Please accept my thanks for the beautiful photograph that you have sent me. It is exceedingly interesting because it clearly shows that the adult form of the *Acanth. Stoliczkanum* var. *spiniferum* is quite different from its middle and younger stages. One of my friends, Mr. d'Anthula, who is engaged in a study of the Cretaceous rocks of the Caucasus, has detected in the Aptien strata (Lower Gault) of that region, a new species (not yet published), the general relations of which have been unsettled up to this time. Its septa remind one of *Acanth. Martinii* and *A. mamillare*, whilst its sculpture has much in common with some species of *Pachydiscus*. But, comparing specimens with your photograph, the resemblance of the type of sculpture in the adult stage (the young stage is not known in the Caucasus specimens), the section, etc., is so great that there can be no doubt that the two forms are allied and that both belong to the genus *Acanthoceras* and to the group of *A. mamillare*. Gabb's type of *Acanth. Stoliczkanum* is certainly related to the European *A. Martinii*, Orbigny, from the Lower Gault (Aptien), and I think that your *A. spiniferum* is distinct from both by its peculiar ornamentation, especially by the greater number of the tubercles in the same stages of growth, and by the compressed outer tubercles which are longitudinally elongated in the direction of the spiral, both characters which connect it well with the group of *A. mamillare*, as stated in a previous letter. To summarize all: I think that the group of *A. Martinii* is represented in California by *A. Stoliczkanum*, whereas *A. spiniferum*, Whiteaves, is related to the group of *A. mamillare*, and shows in adult age some peculiarities of sculpture that have not been known before, but that can be observed in an analogous

development on some Ammonites coming from the Aptien strata of the Caucasus."

It would therefore seem that *A. spiniferum* must be regarded as a distinct species and not as a variety of *A. Stoliczkanum*.

Olcostephanus Loganianus, Whiteaves.

Ammonites Loganianus, Whiteaves. —1876. This volume, pt. 1, p. 27, p. 28, fig. 3; and pl. 8, fig. 2.
Olcostephanus Loganianus, Whiteaves.—1884. Ibid. pt. 3, p. 211, pl. 23, figs. 1 and 1 *a*.

A few specimens of this species were collected by Dr. Newcombe, in 1895, on the south side of Alliford Bay. One of these, though a little worn, is in some respects the best specimen known to the writer.

Olcostephanus cepoides, Whiteaves.

Ammonites Loganianus, Whiteaves (?) Form B.—1876. This volume, pt. 1, p. 30, pl. 8, figs. 1 and 1 *a*.
Stephanoceras cepoides, Whiteaves. —1884. Ibid., pt. 3, p. 210.

A few specimens of a rather small, compressed and remarkably Scaphite-like form of this species, with an obliquely transverse constriction just behind the aperture, were collected by Dr. Newcombe at the east end of Maud Island in 1895, and on the south side of Alliford Bay in 1895 and 1897. A similar but much larger and more coarsely ribbed specimen, with a valve of an oyster over the umbilical cavity on one side, was collected by Dr. Newcombe at Maple Island in 1895. These specimens give the writer the impression that the species is probably an *Olcostephanus* rather than a *Stephanoceras*, but its septation is still unknown.

Olcostephanus (Astieria) Deansii, Whiteaves.

Olcostephanus (*Astieria*) *Deansii*, Whiteaves.—1893. Canad. Record of Science, p. 442, pl. 7, figs. 1 and 1 *a*.

Skidegate Inlet, James Deans: the specimen described and figured in the above mentioned publication,—which is the only one that the writer has seen.

The original description is as follows:—"Shell small, compressed at the sides and narrowly rounded at the periphery: umbilicus occupying rather less than one-third of the entire diameter. Volutions three or four, increasing rapidly in size, especially in the dorso-lateral direction, and rather closely embracing, about two-thirds of the sides of the inner ones being covered, the outer one a little higher than broad;

aperture elliptical in outline but deeply emarginate by the encroachment of the preceding volution.

"Surface marked by numerous, closely arranged, small but distinct, though not very prominent, flexuous, transverse ribs, which bifurcate about the middle of the sides and then pass uninterruptedly over the periphery.

"The sutural lines are so crowded together and confused that, although fairly well preserved in places, it is scarcely possible to follow the details of any single one. The siphonal saddle, however, is small, a little higher than broad, with a minutely trifurcate apex, and an appressed spur on each side below. The first lateral saddle is large, ramose and unequally bipartite or obscurely tripartite at its summit. The siphonal lobe is large and symmetrical, with three branchlets on each side, two of which are lateral and one terminal, but the lowest of the two pairs of lateral branchlets is much the smallest of the three pairs.

"The only specimen collected is considerably eroded near the aperture, as represented in fig. 1, but in the uneroded portion the maximum diameter is about forty millimetres, and the greatest breadth fourteen.

"The writer has much pleasure in associating with this species the name of its discoverer, Mr. James Deans of Victoria, V. I., who accompanied Mr. James Richardson in his exploration of the Queen Charlotte Islands, in 1872, and who has since presented some unusually perfect specimens of the fossils of the Cretaceous rocks of those islands to the Museum of the Geological Survey Department at Ottawa.

"*O. Deansii* appears to belong to the small group of Ammonites of which *Olcostephanus Astieri* is the type, and for which M. Pavlow has recently (1891) proposed the generic or subgeneric name *Astieria*.* According to M. Pavlow, the Olcostephani of the group of *O. Astieri* form a natural group, a genus (*Astieria*) if one prefers to consider the Olcostephani as a family, or a subgenus if one would rather regard *Olcostephanus* as a genus.

"The shape and surface ornamentation of *O. Deansii* are very similar to those of *O. Jeannotti*. But in *O. Jeannotti* the ribs bifurcate at the umbilical margin, and are represented as so prominent as to everywhere break the general contour if the shell is viewed laterally. The siphonal saddles of *O. Jeannotti*, too, are described as broad, and the figures show that they are much broader than high. In *O. Deansii*, on the other hand, the ribs bifurcate half way across the sides, at a considerable distance from the umbilical margin, and are not sufficiently prominent to interrupt the continuity of the outline of the shell in a full side view.

*Bulletin Société Impériale des Naturalistes de Moscou, Année 1891, N. Ser., vol. v. p. 491.

The siphonal saddles of *O. Deansii*, also, are narrow, and, as already stated, a little higher than broad."

Perisphinctes Skidegatensis, Whiteaves.

Ammonites (Perisphinctes) Skidegatensis, Whiteaves.—1876. This volume, pt. 1, p. 34, fig. 4; pl. 7, and pl. 9, fig. 1.
Perisphinctes Skidegatensis, Whiteaves.— 1884. Ibid., pt. 3, p. 210.

A remarkably well preserved and nearly perfect specimen of *P. Skidegatensis*, from the Queen Charlotte Islands, and probably from the Lower Shales at Skidegate Inlet, was presented to the Museum of the Survey in 1893, by the Curator of the Provincial Museum at Victoria, B.C. It measures nearly eight inches in its maximum diameter, and shows the greater part of five volutions. A large fragment, consisting of a cast of the interior of the body chamber, about eight inches in length, of a specimen that is probably referable to *P. Skidegatensis*, was collected by Mr. Robertson, in 1896, at a locality between Yukon Lake and the head of Rennell Sound, and lent to the writer by Dr. Newcombe.

The septation of this shell is still unknown, and Dr. Kossmat, as already stated, thinks that it may prove to be an *Olcostephanus* of the type of the *O. Zirkeli* of Felix and Lenk*, from the Cretaceous rocks of Mexico.

Holcodiscus Laperousianus.

Ammonites Laperousianus, Whiteaves.—1876. This volume, pt. 1, p. 39, pl. 3, fig. 3.
Holcodiscus Laperousianus, Kossmat. —1897. Untersuch. über die südindische Kreideformation, pt. 2, p. 34.

East end of Maud Island, Dr. Newcombe, 1895; a few specimens: north side of Maud Island, three specimens; and Lina Island, one specimen, Dr. Newcombe, 1897.

Holcodiscus Cumshewaensis.

Haploceras Cumshewaense, Whiteaves.—1884. This volume, pt. 3, p. 208, pl. 24, fig. 1.
Holcodiscus Cumshewaensis, Kossmat. —1897. Untersuch. über die südindische Kreideformation, pt. 2, p. 34.

This peculiarly sculptured Ammonite was described and figured from a fragmentary specimen collected on the north shore of Cumshewa Inlet by Dr. G. M. Dawson in 1878. Of late years five other specimens have been obtained at this locality. One of these is a small but comparatively perfect specimen, not quite two inches in its maximum diameter, collected

* Beiträge zur Geologie und Palæontologie der Republik Mexico, theil 3, (1891) p. 182, pl. 29.

by Mr. W. F. Ellis, at Cumshewa Inlet, and lent to the writer by the Natural History Society of British Columbia. On the outer volution of this specimen there are eight or nine narrow and somewhat distant, flexuous constrictions, or narrow grooves, but there is a broad space near the aperture upon which these constrictions are obsolete. Between the constrictions there are about five narrow linear ribs, most of which bifurcate or doubly bifurcate at a short distance from the umbilical margin. The other four specimens were collected by Dr. Newcombe, at Cumshewa Inlet, in 1895. One of these measures about four inches and a half in its maximum diameter and is the largest specimen that the writer has seen. On the interior half of its outer volution the periodic constrictions or arrest of growth are undeveloped or obsolete. The transverse ribs on the outer volution of this specimen too, are not thin and sharp, but comparatively broad, and flattened at their summits, on and near the periphery or venter, especially near the aperture. The sutural line of the species is still unknown.

Hoplites Haidaquensis.

Hoplites Haidaquensis, Whiteaves. —1893. Canad. Rec. Sc., vol. VI, p. 444, pl. 7, figs. 2, & 2, *a-b*.

"Shell small, strongly costate and widely umbilicated, the umbilicus, as measured from suture to suture, occupying about one-third of the entire diameter. Volutions about three, though the nucleus is not preserved in the only specimen collected, increasing rather rapidly in size and slightly embracing: the outer one moderately convex, a little broader than high, the outline of a transverse section being subpentagonal if made through one of the ribs, or not far from circular if in the centre of one of the grooves between them: aperture nearly circular but shallowly emarginate by the encroachment of the preceding volution.

"Surface marked by large and prominent, simple and nearly straight, transverse ribs, which are separated by rather broad concave grooves. The ribs, which are equal in length, are most elevated on the outer or peripheral portion of the last volution, and in the median line of the periphery there is a single angular notch on each rib which scarcely interrupts the continuity of the rib.

"Sutural line not clearly defined, but apparently not very complicated nor much branched. The first and second lateral saddles appear to be much broader than high, and doubly incised rather than ramose at the summits. The first lateral lobe seems to be trifurcate above and unusually small, though apparently much larger than any of the others except the siphonal lobe.

"Maximum diameter of the only specimen collected, twenty-nine millimetres: greatest breadth of the same, twelve mm.

"The specific name suggested for this little Ammonite is a modification of the word Hai-da-kwe-a, which Dr. G. M. Dawson quotes as the Indian name for the Queen Charlotte Islands, in his report on these islands, published in the Report of Progress of the Geological Survey of Canada for 1878-79.* The shell itself appears to belong to the sub-group Dentatiregulares of the Dentati, of Pictet's classification of the Ammonites in the "Paléontologie Suisse,"† and to that section of the genus *Hoplites* which Zittel calls the group of *Ammonites interruptus.*‡ In many of its characters it is very similar to *Hoplites sinuosus*, but it seems to have fewer and more distant ribs than that species and a different sutural line. Thus the type and only known specimen of *H. Haidaquensis* has twenty-two ribs on the outer volution, while that of *H. sinuosus*, which is almost exactly the same size, is said to have thirty-four. The sutural line of *H. Haidaquensis* seems to be more like that of *H. crassicostatus*, as figured by d'Orbigny,‖ in which the first and second lateral saddles are represented as broader than high, whereas the corresponding saddles of *H. sinuosus* are represented as higher than broad." (Op. cit.)

Hoplites Yakounensis. (N. Sp.)

Plate 36, figs. 1, 1 *a* and 1*b*.

Shell small, compressed, rather narrowly umbilicated, periphery or venter narrow and subtruncated. Volutions so deeply embracing that the greater part of each of the inner ones is covered, the umbilicus occupying a little less than one-third of the entire diameter, the outer one flattened somewhat obliquely outward from the margin of the umbilicus. Aperture narrowly elongated, much higher or longer than wide, subtruncate both above and below, widest and deeply emarginate below.

Surface of each side of the outer volution marked with a single row of about ten small, transversely elongated, conical tubercles on the umbilical margin, and with a corresponding row of from two to three times as many small, obliquely and slightly elongated tubercles on the outer margin of the periphery or venter. Across each of the sides these two sets of tubercles are connected by faint, obscure and almost obsolete, radiating and bifurcating costæ, but a few of the tubercles on the peripheral margin mark the termination exteriorly of short intercalated ribs that do not reach to the umbilical margin.

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* Page 104B.

† Première par[illegible]

‡ Handbuch der Palæontologie, vol. II, p. 476.

‖ Paléontologie Française, Terrains Crétacés, tome 1, Atlas, pl. 59, fig. 3.

Sutural line not sufficiently well preserved to admit of an exact description of the whole or even of most of it.

East end of Maud Island, one imperfect specimen about forty millimetres, or a little more than an inch and a half, in its maximum diameter; and two miles south of Yakoun Lake, a similar but rather smaller specimen; both collected by Dr. Newcombe in 1895.

From its general resemblance to the *Ammonites denarius* of Sowerby, as figured by D'Orbigny, this small Ammonite would seem to belong to what Zittel calls the group of *A. interruptus*, Brug., and to be most nearly related to *Hoplites Vancouverensis* (the *Ammonites Vancouverensis* of Meek) and to *Pachydiscus Gollevillensis*, (D'Orbigny) as recently illustrated by Kossmat. *H. Vancouverensis*, however, is a much larger species, the shell of which, when adult, attains to a maximum diameter of nearly five inches. Its periphery or venter, too, is more flattened, and the tubercles which bound it on each side are elongated at almost a right angle to the ribs from which they proceed, so that each pair of tubercles is parallel, and not convergent forward, as those of *H. Yakounensis* are. *P. Gollevillensis*, has a proportionately wider umbilicus than that of the present species, and the tubercles on the outer margin of each side of the outer volution of the former are more nearly transverse to it.

Hoplites Newcombii. (N. Sp.)

Plate 37, figs. 1 and 1*a*.

Shell small, moderately convex but somewhat compressed laterally, and rather widely umbilicated. Volutions about five, the later ones lightly embracing, so that about one-half of the sides of the inner ones are exposed in the umbilicus. Outer volution a little broader than high, rounded subhexagonal in transverse section: umbilicus occupying about one-third of the entire diameter, though its margin is rounded and indistinctly defined.

Surface marked by very numerous, close-set, thin and sharp transverse ribs, most of which bifurcate from a minute flattened spinose tubercle, at a short distance from the umbilicus, pass over the venter and reunite at a corresponding tubercle on the opposite side. Between two of these longer and continuous ribs, a short and simple rib is frequently intercalated.

Sutural line unknown.

Maximum diameter of the only specimen known to the writer, thirty-six millimetres: breadth of the outer volution at the aperture, sixteen mm. and a half.

South side of Alliford Bay, Dr. Newcombe, 1895: a single well preserved specimen.

This delicately sculptured fossil is not at like any American species of Ammonite that the writer is acquainted with, and seems to be nearest to the *A. Gargasensis* of the French Neocomian, though perfectly distinct therefrom. The specific name proposed for the former is in honour of its discoverer, Dr. C. F. Newcombe, who has done so much to advance our knowledge of the geology, palæontology and ethnology of British Columbia, and who collected most of the specimens that are described or enumerated in this paper.

Desmoceras latidorsatum, Michelin. (Sp.)

Ammonites latidorsatus, Michelin. 1838. Mém. Soc. Géol. France, vol. III, p. 101, pl. 12, fig. 9.
" " D'Orbigny. 1840. Pal. Franc., Terr. Cret., vol. I, p. 270, pl. 80.
" " Pictet and Roux. 1847. Foss. des Gres Verts, p. 44, pl. 3, figs. 4 and 5.
" " Stoliczka. 1865. Cret. Cephalop. S. India, p. 148, pl. 74, figs. 1–4.
Ammonites inanis, Stoliczka. 1865. Ib., pl. 59, fig. 14.
Desmoceras latidorsatum, Kossmat. 1897. Untersuch. üb. die südindische Kreideformation, pt. 3, p. 107 (172), pl. 19 (25), figs. 2, *a–b*; 3, *a–b*; 4, *a–b*; and 5.

A few specimens, that agree very well with the descriptions and figures of this species, were collected by Dr. Newcombe in 1895 at Bear Skin Bay and at the east end of Maud Island. All of those that the writer has seen are mere casts of the shell, with the sutures of the septa either not preserved at all, or with their finer details almost obliterated by weathering. The largest and most perfect specimen is eighty-eight millimetres in its greatest diameter, and forty-three mm. in breadth or thickness near the aperture. It shows seven flexuous transverse constrictions on the outer volution, with tongue-like processes on the venter, but there are probably two or three more of these constrictions, as the posterior end of that volution is covered with the matrix. Between them, and parallel with them, there are remains of low, faint and close set costulæ. In another specimen the outline of a transverse section of the body chamber near the aperture is crescentic, the venter and sides being rounded and the dorsum broadly and deeply grooved for the reception of the previous volution.

The largest of the five specimens from South Island, and the two specimens from Bear Skin Bay, that were identified with *Lytoceras Timotheanum* on page 203 of the third part of this volume, are now believed to be referable to *Desmoceras latidorsatum*.

Desmoceras (Puzozia) planulatum? Sowerby. Var.

Plate 36, fig. 2; and pl. 37, fig. 2.

Haploceras planulatum, Whiteaves. 1884. This volume, pt. 3, p. 207, pl. 28, fig. 1.

In the third part of this volume three imperfect and badly preserved Ammonites from Cumshewa Inlet were identified with the *Ammonites planulatus* of Sowerby, Sharpe and Stoliczka. The small one figured on Plate 28, has part of the test preserved, but so much of the periphery of the outer volution is worn away that its umbilicus appears to be wider proportionately than it really was. In this specimen both the venter and the sides are compressed, the transverse section being subquadrangular in outline, but higher or longer than broad, and concavely emarginate below. On the outer volution there are seven distant, slightly flexuous, transverse constrictions, which are flatly arched in crossing the venter. The ribs, which run parallel to them, are thin, sharp and separated by comparatively wide shallow grooves. The two large specimens referred to on page 207 are septate throughout and show the general shape fairly well, also the characters and relative proportions of the umbilicus. In the larger of the two the umbilicus appears to occupy a little more, and in the smaller a little less, than one-fourth of the entire diameter. The larger has all the surface markings obliterated by weathering, but the smaller is regularly ribbed and marked by seven or eight distant constrictions on the outer volution. The ribs are not very prominent, and narrower than the grooves between them.

Quite recently three specimens, which are apparently referable to this variety of *D. planulatum*, have been lent to the writer by Dr. Newcombe. One of these was collected at Cumshewa Inlet by Mr. Maynard Smith in 1892, and the other two at Maple Island by Dr. Newcombe in 1895. The Cumshewa specimen is a slightly distorted cast of the interior of most of the septate portion of the shell, with small portions of the test preserved. It measures about eleven inches in its maximum diameter, and about four inches in thickness. It is much more convex proportionately than the two large specimens from the same locality collected by Dr. Dawson. Owing to the distortion, the comparative size of the umbilicus of the specimen collected by Mr. Smith cannot be ascertained with much accuracy, but it can scarcely have occupied much more than one-fourth of the entire diameter. There are only five, distant and nearly straight, transverse constrictions, on its outer volution. The ribs, which though well marked, are low, rounded at their summits and narrower than the grooves between them, are usually simple, with an occasional shorter rib intercalated between two of the longer ones. The two specimens from Maple Island are both much compressed laterally. The more perfect of the two, the one figured, is a slightly crushed, septate cast about six inches and a half in its maximum diameter, and about one inch and three-quarters in thickness, allowing for the distortion. Its umbilicus occupies nearly one-third of the entire diameter, and on its outer volution there

are seven distant periodic constrictions, or transverse grooves, which are slightly flexuous and somewhat sigmoidal on the sides, and very little arched on the venter. Between these constrictions there are faint indications of low, rounded ribs, which are obsolete at and near the umbilical margin. The other is an imperfect, but undistorted cast of the interior of the septate portion of the shell and of most of the body chamber, not quite six inches and a quarter in its greatest diameter, and an inch and three quarters in breadth. In other respects the characters of these two specimens are essentially the same.

Professor Yokoyamo, in his monograph of the fossils of the Japanese Chalk, published at Stuttgart in 1890, claims that the *Ammonites planulatus* of Stoliczka is not the *A. planulatus* of Sowerby, but the *A. Gaudama* of Forbes, and refers both to *Desmoceras*. He also includes the "*Haploceras planulatum*" nobis, of page 207 of the third part of this volume, though with a query prefixed, among the synonyms of *Desmoceras Gaudama*. Dr. Kossmat, on the other hand, (who regards *Ammonites planulatus*, Sowerby, as the type of the subgenus *Puzozia* of the genus *Desmoceras*, divides the *Ammonites planulatus* of Stoliczka into three species, which he calls *Puzozia planulata*, Sowerby, var. *Odiensis*, Kossmat; *P. Gaudama* (Forbes); and *P. crebrisulcata*, Kossmat. He states also that "Whiteaves' *A. planulatus* from Division C (Middle Cretaceous) of the Queen Charlotte Islands, exhibits lesser involution and coarser ribbing (geringere Involution und gröbere rippung)" than the typical *A. planulatus* of Sowerby. But, unfortunately, Dr. Kossmat has not seen any of the specimens of the supposed *A. planulatus* from Cumshewa or Maple Island, or even photographs of them, but only the figure, without any description, of the small and very imperfect specimen on Plate 28, fig. 1, of the third part of the present volume. In the writer's judgment, all these specimens agree fairly well with the descriptions and figures of *Desmoceras (Puzozia) planulatum* (Sowerby) as recently restricted, and differ from them only, so far as can be observed at present, in being a little more tightly rather than more loosely coiled, and, more particularly, in their much straighter periodic constrictions or arrests of growth.

Desmoceras (Puzozia) Brewerii.

Ammonites Brewerii, Gabb. —1864. Geol. Surv. Calif., Palæont., vol. I, p. 62, pl. 10, fig. 7; and (1869) vol. II, p. 130, pl. 20, fig. 5.

" " Whiteaves —1876. This volume, pt. 1, p. 21, pl. 1, figs. 2, 2 *a*, and 3, 3 *a*.

A specimen collected at Maud Island by Mr. James Deans in 1898, which is essentially similar to the original of figure 3 on Plate I, of this

volume, has been lent to the writer by the Natural History Society of British Columbia.

Since then Dr. Newcombe has lent to the writer nine specimens that are clearly referable to this species, from two to seven, and even nine inches in their maximum diameter, that he collected at the east end of Maud Island in 1895. Seven of these, including the largest and the largest but one, are marked by large and comparatively distant flexuous, plications which are strongly developed on the sides, but obsolete, or nearly obsolete on the venter. In the largest of these specimens some of the plications are as much as fourteen millimetres apart at their summits, on the outer portion of each of the sides.

A specimen with extremely small and comparatively close-set, flexuous radiating, raised lines, which is apparently referable to this species, was collected at a locality north-west from Yakoun Lake, on the Rennel Sound Trail, by Mr. S. Pearse in 1894, and lent to the writer by Dr. Newcombe.

From the whole of this new material it would appear that the fossil described on page 23, and figured on Plate 1, figures 3 and 3*a* of the first part of this volume as a dwarfed costate variety of *Ammonites Breweri* is really a small specimen of the typical form of the species, and that the "presumed typical form" described on page 22 of the same publication and represented on Plate 1, figs. 2 and 2*a*, is a less typical and smoother variety, more nearly related to the next species.

Desmoceras (Puzozia) Haydenii.

Ammonites Haydenii, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. 1, p. 62, pl. 10, figs. 5, & 8 *a-b*.

The writer has long been under the impression that the six specimens referred to on page 23 of the first part of this volume as closely resembling *A. Haydenii*, are really referable thereto. Quite recently Prof. John C. Merriam, who has kindly compared some of these specimens with the types of *A. Haydenii* in the Geological Museum of the University of California at Berkeley, has expressed himself as satisfied with the identity of these two forms. Specimens similar to those obtained by Mr. Richardson were collected at the east end of Maud Island by Dr. Newcombe in 1895, but it seems to the writer that *A. Haydenii* is only a small, smooth form of *A. Brewerii*.

Desmoceras (Puzozia) Perezianum.

Ammonites Perezianus, Whiteaves. 1876. This volume, pt. 1, p. 19, pl. 2, figs. 1 and 1*a*. But not *A. Perezianus*, D'Orbigny, 1850, Prodr. de. Paléont., p. 9.

Haploceras Perezianum, Whiteaves. 1884. This volume, pt. 3, p. 204.

Placenticeras Perezianum, Whiteaves. 1889. Contr. Canad. Pàlæont., vol. 1, pt. 2, p. 156.
Desmoceras Perezianum, Whiteaves. 1893. Trans. Royal Soc. Canada for 1892, vol. x, sect. 4, p. 114.

Skidegate Channel, west of Alliford Bay, J. Richardson, 1872; South Island (in Skidegate Channel) and north shore of Cumshewa Inlet, Dr. G. M. Dawson, 1878: the specimens referred to on pages 19 and 204 of this volume.

This species was referred to *Haploceras* in 1884 in accordance with Neumayr's classification of the Cretaceous Ammonites, and to *Placenticeras* in 1889, as appearing to agree with Zittel's extended definition of its characters in the second volume of the Handbuch der Palæontologie. It, however, appears to be a fairly typical species of *Desmoceras*, Zittel, (1884) as that genus is now understood.

Desmoceras (Puzozia) Dawsoni. (N. Sp.)

Plate 37, fig. 3.

Haploceras Beudanti, Whiteaves. 1884. This volume, pt. 3, p. 205, pl. 26, figs. 1 and 1*a*. But probably not the *Ammonites Beudanti* of European authors, nor of Stoliczka.

Shell resembling that of *Puzozia Stoliczkai*, Kossmat* (the *Ammonites Beudanti* of Stoliczka, but not of Brongniart nor D'Orbigny) in shape, septation, and in the large size to which it attains, but differing therefrom, as pointed out by Dr. Kossmat,† mainly in the circumstance that the periodic constrictions of specimens of from two to three or five or six inches in their maximum diameter, are much more flexuous and sigmoidal.

Abundant on the north shore of Cumshewa Inlet, where numerous specimens were collected by Dr. G. M. Dawson in 1878 and by Dr. Newcombe in 1895. At this locality all the specimens have the umbilical margin rounded, and this would seem to be the typical form of the species. The few specimens from Bear Skin Bay, collected by Dr. Dawson in 1878, with a rectangular umbilical margin, should probably be regarded as a variety of *Desmoceras Dawsoni*, for although they very closely resemble the *Ammonites Beudanti* as figured by Pictet and Campiche, it would now seem that more than one species has been described under that name by European writers.

Desmoceras (Puzozia) Maudense.

Sphenodiscus Maudensis, Whiteaves. 1884. This volume, pt. 3, p. 200, pl. 22, figs. 3 and 3, *a-b*.

Bear Skin Bay, C. F. Newcombe, 1895: an imperfect and badly preserved cast of the interior of a shell, about five inches in its maximum

* Untersuchungen über die südindische Kreideformation, pt. 3. (184) 119, pl. (24) 18, fig. 6.

† Ibid., p. (185) 120.

diameter, that may possibly be referable to this species. Its venter however, is very narrowly rounded rather than carinate, but the venter of the type of *Sphenodiscus Maudensis* would be better described as obscurely subcarinated than as inconspicuously carinated. The sutural line of this latter specimen, as represented on Plate 22 of this volume, seems to be more like that of *Desmoceras* than of *Sphenodiscus*.

Gasteropoda.

Trochactæon cylindraceus? Stoliczka.

Actæonina (Sp. undt.) Whiteaves. 1876. This volume, pt. 1, p. 53.
Trochactæon cylindraceus (Stoliczka) Whiteaves. 1884. Ibid., pt. 3, p. 218, pl. 28, fig. 6.

East end of Maud Island, several specimens; and Bear Skin Bay, one specimen; all collected by Dr. Newcombe in 1895.

These are precisely similar to the specimens previously collected by Mr. Richardson and Dr. Dawson. They are all more or less crushed, distorted and badly preserved casts of the interior of the shell. Their identity or otherwise with *T. cylindraceus* is consequently very uncertain, and it would probably have been better to have distinguished them provisionally by a different specific name, such as *T. Skidegatensis*.

Amauropsis tenuistriata, Whiteaves.

Amauropsis tenuistriata, Whiteaves. 1876. This volume, pt. 1, p. 48, pl. 9, figs. 4 and 4 *a*; and (1884) pt. 3, p. 216, pl. 28, fig. 3.

East end of Maud Island, one cast of the interior of the shell and one specimen with the test preserved; and — Peninsula, Cumshewa Inlet, eight casts of the interior of the shell; all collected by Dr. Newcombe in 1895.

Scalaria Clementina (Michelin) d'Orbigny.

Melanopsis Clementina, Michelin. 1833. Magas de Zoologie, pl. 39.
" " " 1838. Mém. Soc. Géol., tome 3, p. 99.
Scalaria Clementina, d'Orbigny. 1842. Pal. Franc., Terr. Cret., tome II, p. 52, pl. 154, figs. 6-9.
" " Pictet and Campiche. 1862. Paléont. Suisse, Foss. Terrains Cret. Envir. Sainte-Croix, deuxieme partie, p. 333, pl. 72, figs. 12 and 13.
Scalaria Albensis?? d'Orbigny. Whiteaves. 1876. This volume, pt. 1, p. 50, pl. 9, fig 5.

Cumshewa Inlet, at a locality about two miles west of the Peninsula and close to the Oil Works, C. F. Newcombe, 1895: a cast of the interior of four of the volutions, with part of the test preserved.

When the fragment referred to on pages 50 and 51, and figured on Plate 9 of the first part of this volume was doubtfully identified with the

Scalaria Albensis of d'Orbigny, Pictet and Campiche's monograph on the Cretaceous fossils of the environs of Ste. Croix was not accessible to the writer. Both it and the specimen collected by Mr. Richardson are practically indistinguishable from Pictet and Campiche's figures of *S. Clementina*, and would now seem to be referable to that species rather than to *S. Albensis*.

Pleurotomaria Skidegatensis.

Pleurotomaria Skidegatensis, Whiteaves. 1876. This volume, pt. 1, p. 51, pl. 9, figs. 6 and 6 *a*.

East end of Maud Island, a specimen with part of the test preserved; and south side of Alliford Bay, a large cast of the interior of a shell, which is probably referable to this species; both collected by Dr. Newcombe in 1895.

Pelecypoda.

Anatina (Cercomya) semiradiata. (N. Sp.)

Plate 37, fig. 4.

Shell strongly compressed, transversely elongated, more than twice as long as high, straight, or at least not distinctly curved. Anterior side shorter, a little broader (in the direction of its height) and more broadly rounded at the end than the posterior; beaks appressed and depressed, placed in advance of the midlength.

About one-third of the distance from the front margin to the posterior extremity there is a faint transverse groove or narrow depression in the cast of each valve. In front of this groove the surface is concentrically and coarsely plicated. Behind it the concentric plications are more feebly developed, and immediately next to it there is a broad submedian triangular area, marked also with fine radiating ridges. But no vestige of the test is preserved in either of the only two specimens that the writer has seen, so that the hinge dentition is unknown. The muscular impressions also are not preserved.

East end of Maud Island, a tolerably well preserved and nearly perfect, but slightly distorted cast of the interior of both valves; and south side of Alliford Bay, a similar, but rather larger, less perfect and worn cast; both collected by Dr. Newcombe in 1895.

A very similar shell to the recently described *Anatina (Cercomya) punctata*, Stanton,* of the Jurassic rocks of the Yellowstone National Park.

*Geology of the Yellowstone National Park. Monograph xxxii of the United States Geological Survey (1899), p. 628, pl. 74, fig. 5.

Thracia semiplanata, Whiteaves.

Thracia semiplanata, 1884. This volume, pt. 3, p. 221, pl. 29, figs 5, 5, *a-c*.

East end of Maud Island, five good specimens; and Creek near Camp Robertson, two miles south of Yakoun Lake, at an elevation of about 600 feet above the level of the sea, one small specimen; all collected by Dr. Newcombe in 1895.

Pleuromya papyracea, var. Carlottensis.

Pleuromya Carlottensis, Whiteaves. 1876. This volume, pt. 1, p. 57, pl. 9, fig. 8.

Pleuromya subcompressa, Whiteaves. 1884. Ibid., pt. 3, p. 22, pl. 29, fig. 6. But probably not *Myacites* (*Pleuromya*) *subcompressa*, Meek, if that is a Jurassic species.

Pleuromya subcompressa, var. *Carlottensis*, Whiteaves. 1884. Ibid., pt. 3, p. 223, pl. 29, figs. 7, and 7*a*.

South side of Alliford Bay, C. F. Newcombe, 1895: one good specimen.

The types of *Pleuromya papyracea*, Gabb, which are now in the Museum of the Academy of Natural Sciences of Philadelphia, have been kindly lent to the writer by Dr. H. A Pilsbry. They consist of a nearly perfect and well preserved cast of the interior of both valves of an apparently adult shell, forty-five millimetres in length, with small portions of the test preserved, (evidently the original of Plate 29, fig. 66, of the second volume of the Palæontology of California); of an imperfect cast of the interior of a half-grown right valve; and of three very small casts of the interior of both valves, the largest of which is not more than three-quarters of an inch in length.

From a direct comparison with these specimens it would seem that all the concentrically ribbed Pleuromyæ from the Queen Charlotte Islands that are described and figured in the first and third parts of this volume should probably be regarded as representing a local and coarsely costate or plicate variety of *P. papyracea*.

Dr. Stanton has expressed the opinion* that *Pleuromya lævigata*, Whiteaves, is a synonym of *P. papyracea*, but, in the writer's judgment, these two forms are quite distinct, *P. lævigata* being much smaller than *P. papyracea*, different in shape and almost smooth, its outer surface being marked only with a few concentric lines of growth.

Pleuromya lævigata, Whiteaves.

Pleuromya (subcompressa? var.*) lævigata*, Whiteaves. 1884. This volume, pt. 3, p. 224, pl. 30, 1, 1, *a-c*.

The specimens from Alliford Bay and Maud Island, and probably also those from the Iltasyouco River and "Lower Sandstones" of the south

*In a foot note to page 18 of Bulletin No. 133 of the United States Geological Survey.

side of Maud Island, referred to on pages 224 and 249 of the third part of this volume. But, in the present state of our knowledge, *P. lævigata* can scarcely be regarded as a variety of *P. subcompressa*, if the latter is of Jurassic age.

Cytherea (Caryatis) subtrigona, Whiteaves.

Callista (?) subtrigona, Whiteaves. 1876. This volume, pt. 1, p. 63, pl. 9, fig. 10.
Caryatis subtrigona, Whiteaves. 1884. Ibid., pt. 3, p. 226.

Bear Skin Bay, Skidegate Inlet, C. F. Newcombe, 1895 : several specimens. Three miles north-west from Yakoun Lake on the Rennel Sound Trail : a right valve collected by S. Pearse in 1894, and loaned to the writer by Dr. Newcombe in 1895.

Thetis affinis, Whiteaves.

Thetis affinis, Whiteaves. 1884. This volume, pt. 3, p. 226, pl. 30, figs. 4 and 4, *a b*.

Three miles north-west from Yakoun Lake on the Rennel Sound Trail, three casts of the interior of both valves, collected by S. Pearse in 1894 and lent to the writer by Dr. Newcombe in 1896.

Cyprina occidentalis, Whiteaves.

Cyprina occidentalis, Whiteaves. 1884. This volume, pt. 3, p. 227, fig. 10.

Lina Island, Skidegate Inlet, C. F. Newcombe, 1897 : a cast of the interior of both valves.

Protocardia subsimile. (N. Sp.)

Protocardium Hillanum, Whiteaves. 1884. This volume, pt. 3, p. 228, pl. 30, fig. 5.
But probably not *Cardium Hillanum*, Sowerby, 1813.

Shell small, regularly convex, ovately subtriangular, rather narrow above, widening somewhat rapidly below, and nearly as high as long. Anterior side short, subtruncated somewhat obliquely above and narrowly rounded below : posterior side not much longer than the anterior, more obliquely truncated above, rather more produced, and obtusely pointed below : cardinal margin short, umbones moderately prominent : beaks small, curved inward and forward, placed a little in advance of the midlength.

Posterior area of both valves marked by minute radiating ribs, the remainder of the surface with still more minute and densely crowded concentric raised lines.

Dimensions of the only testiferous specimen that the writer has seen (a right valve): length nine millimetres and a half ; height, inclusive of the beaks, nine mm.

East end of Maud Island, Dr. G. M. Dawson, 1878 : the "perfect right valve" referred to *P. Hillanum* on page 228, and figured on Plate 30, fig. 5, of this volume. A few small but well preserved casts of the interior of shells which are probably referable to this species, were collected on the south side of Alliford Bay by Dr. Dawson in 1878 and by Dr. Newcombe in 1895.

Judging by Sowerby's original description and figure of *Cardium Hillanum*, from the Greensand of Blackdown, the Maud Island specimen would seem to be a very much smaller shell, with a somewhat different marginal outline. As figured in the "Mineral Conchology", *C. Hillanum* is an inch and three-quarters in its maximum length, but the Maud Island right valve may not be that of an adult shell.

Meekia sella, Gabb.

Meekia sella, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 191, pl. 25, fig. 179.
Periploma cuspidatum, Whiteaves. 1884. This volume, part 3, p. 220, pl. 29, figs. 4 and 4, *a-b*.

Bear Skin Bay, Skidegate Inlet, C. F. Newcombe, 1895 : one specimen.

The types of *Periploma cuspidatum* from Maud Island are badly preserved casts of the interior of small specimens, with the valves spread out, which show nothing more than the marginal outline of the shell and a short groove in each valve, curving downward and a little outward on one side of the beak. The largest of these casts is twenty-eight (not "twenty") millimetres in its maximum length, and twenty-four and a half in height. From their general appearance it was supposed that the shorter and "abruptly cuspidate" side was analogous to the beaked posterior side of *Cuspidaria* or *Pandora*, and that the umbonal groove corresponded to the impression of the obliquely transverse, posterior internal rib seen in so many of the Cretaceous Anatinidæ and especially in *Corimya*. It was, however, fully recognized that the marginal outlines of these specimens is singularly like that of the *Meekia sella*, as figured by Gabb.

Quite recently, by the courtesy of Professor Pilsbry, the types of *Meekia sella*, from Martinez, in the Museum of the Academy of Natural Sciences of Philadelphia, have been lent to the writer for examination and comparison. They consist of seventeen different valves, of all sizes, some of which are perfect and well preserved, with the whole of the test remaining. The largest, which is not the one figured by Gabb, is a perfect left valve, fifty millimetres in length, by forty-four in height. These specimens show clearly that the test of *M. sella* is porcellanous and comparatively thick, not subnacreous and thin as in *Periploma* proper : also that

the pallial line is entire, and not sinuated like that of *Periploma*. Further, the lunule of these Martinez specimens is well defined, and the shorter subcuspidate side of *M. sella* seems to be anterior, as described by Gabb.

The writer is now under the impression that the types of *P. cuspidatum* are mere badly preserved casts of the interior of valves of small specimens of *M. sella*, and that the supposed posterior umbonal groove of the former is the impression of what Gabb calls the "short robust plate" which "separates the anterior muscular scar" of *Meekia* "from the cavity of the beaks".

Conrad's statement (in the first volume of the American Journal of Conchology) that *Meekia sella* is probably the same as *Cyprina bisecta*, can scarcely be correct, as the latter shell would seem to be a well characterized species of *Axinus*. Capt. Vogdes (on page 8 of his "Bibliography relating to the Geology, Palæontology, and Mineral Resources of California") in reference to the genus *Meekia*, says, "there is already a genus *Meekella*, so this will not stand," but he does not seem to be aware that *Meekia* was published by Gabb in 1864, and *Meekella* by White and St. John (for a genus of Carboniferous brachiopoda) in 1868.

Astarte Carlottensis, Whiteaves.

Astarte Packardi, Whiteaves. 1884. This volume, part 3, p. 229, pl. 30, figs. 6, and 6, *a-b*. But probably not *A. Packardi*, White, 1880.
Astarte Carlottensis, Whiteaves. 1889. Contr. Canad. Palæont., vol. I, pt. 1, p. 154.

East side of Alliford Bay, four large and beautifully preserved specimens, with the test, and a few fragments; south side of Alliford Bay, abundant in the condition of small but perfect casts; east end of Maud Island, five small examples with the test preserved; G. M. Dawson, 1878.

Trigonia diversicostata, Whiteaves.

Trigonia diversicostata, Whiteaves. 1876. This volume, part I, p. 68, pl. 10, fig. 1; and (1884) pt. 3, p. 230.

An imperfect and badly preserved left valve, which is probably referable to this species, was collected at the east end of Maud Island by Dr. Newcombe in 1895. Two small Trigonias, also, collected three miles north-west from Yakoun Lake, on the Rennel Sound Trail, by Mr. S. Pearse in 1894, have been lent to the writer by Dr. Newcombe. One of these is clearly an imperfect but well preserved right valve of *T. diversicostata*. The other, which is a perfect detached specimen, with both valves, but with some of the finer surface markings obscured by remains of the tenacious matrix, is apparently an abnormal variety of that species,

with the angular and subconcentric ribs or plications almost obsolete. A little *Trigonia*, from the Cretaceous rocks on the south side of the entrance to Quatsino Sound, V.I., collected by Mr. Hunt of Alert Bay, and lent to the writer by Dr. Newcombe, is probably a short, ventricose variety of *T. diversicostata*.

Arca (Nemodon) similima. (N. Sp.)

Nemodon Fischeri, Whiteaves. 1884. This volume, pt. 3, p. 234, pl. 31, fig. 5. But probably not *Arca Fischeri*, d'Orbigny, 1850, which is a Russian Jurassic species.

Shell moderately convex, narrowly elongated, nearly three times as long as high and very inequilateral. Anterior side short, anterior end forming an angular junction with the cardinal border above, thence curving abruptly and obliquely, inward and downward, to the ventral margin below: posterior side fully four times as long as the anterior, posterior end truncated somewhat obliquely and very shallowly concave above, narrowly rounded and a little produced below: cardinal margin straight and slightly ascending from the anterior to the posterior end: umbones broad but not very prominent, placed at a short distance from the anterior end: beaks rather widely separated, small and incurved: cardinal area rather large, marked by continuous longitudinal grooves, which are a little bent opposite the beaks: ventral margin shallowly concave a little in advance of the midlength, narrowly rounded in front of this sinus, much broader and nearly straight behind.

Surface marked by very numerous, small, radiating ribs, and by concentric striæ and lines of growth.

Hinge dentition apparently as in *Nemodon* (Conrad) and consisting of three short, longitudinal, anterior teeth, parallel to the cardinal border, with some granulous teeth opposite the beaks, and of two very long, laminar posterior teeth, which are also parallel to the cardinal border.

East end of Maud Island, Dr. G. M. Dawson, 1878: several well preserved and nearly perfect specimens.

In a previous part of this volume these specimens were identified with *Arca Fischeri*, d'Orbigny, on the strength of Eichwald's statement that that species is from rocks of Neocomian age. These rocks are now regarded as Jurassic, and although the figures of *A. Fischeri** in the second volume of the Geology of Russia in Europe and the Ural Mountains are remarkably similar to the Maud Island specimens, it is scarcely probable that a North American Cretaceous fossil is identical with a Russian Jurassic species.

* Under the name *Arca concinna*, von Buch, which D'Orbigny himself subsequently changed to *A. Fischeri*.

Arca (Nemodon) Cumshewensis. (N. Sp.)

Grammatodon inornatus, Whiteaves. 1884. This volume, pt. 3, p. 235, pl. 31, figs. 8, 8, *a-b*. But probably not *G. inornatus* of Meek and Hayden, (1858) which is said to be a Jurassic species.

Shell, or rather cast of the interior of the shell, small, moderately convex, about one-third longer than high, inclusive of the beaks, and very inequilateral. Anterior side shorter than the posterior: anterior end angular at its junction with the cardinal margin above, rounded and narrowing rapidly inward and downward to the base below: posterior end obliquely subtruncated above, slightly produced and rounded more or less narrowly, in some specimens obtusely pointed, below: ventral margin (or base) nearly straight or but very gently convex for the greater part of its length: superior border, behind the beaks, straight and almost parallel with the ventral margin: umbones broad and moderately prominent, beaks curved inward and forward, placed in advance of the midlength: posterior area tolerably well defined in some specimens but not in others.

Test unknown: surface of well preserved casts of the interior of the shell marked by numerous, closely disposed, minute concentric striæ and by minute, obscure, radiating raised lines. Hinge dentition not well shown in any of the specimens known to the writer, but in one of the casts there are distinct impressions of two or three longitudinally elongated posterior teeth, parallel to the hinge line, in the left valve.

The six specimens collected at Cumshewa and Skidegate inlets by Dr. G. M. Dawson in 1878 and referred to on page 235 of the third part of this volume, are the only ones that the writer has seen.

Cucullæa ponderosa. (N. Sp.)

Plate 38, figs. 1 and 1*a*.

Cucullæa (?) Sp. Undt. Whiteaves. 1876. This volume, pt. 1, p. 73.
Cucullæa (*Idoneearca*). Species undeterminable. Whiteaves. 1884. Ibid., pt. 3, p. 235.

Shell large, ventricose, subtrapezoidal and very inequilateral: valves so strongly convex in the umbonal region that their maximum breadth or thickness, when closed, exceeds their greatest height, inclusive of the beaks: test thick. Anterior side short: anterior end angular above, at its junction with the cardinal margin, and broadly rounded below: posterior side broader and a little longer than the anterior: posterior end obliquely truncate above and obtusely pointed below. Ventral margin curved rather convexly in advance of the midlength, straighter behind: superior border nearly straight, ascending slightly and very gradually from the anterior to the posterior end: umbones prominent, broad and rather obtuse: beaks widely distant, depressed, curved inward and a little

forward, placed in advance of the midlength : cardinal area very large, broad and marked with well defined, divergent, ligamentary grooves : posterior area not distinctly defined, indicated only by an abrupt inflection of the valves.

The foregoing description is based almost exclusively upon the large and presumably adult specimen figured on Plate 38, which was collected at the east end of Maud Island, by Dr. Newcombe, in 1895. The surface of this specimen is not very well preserved, and its markings consist only of closely disposed concentric striæ. In the small, crushed and imperfect, but testiferous specimen from the same locality, described on page 235, of the third part of this volume, the surface markings are well preserved and consist of numerous and densely crowded minute concentric raised lines, with a few rather coarser incremental ones, both of which are crossed by almost equally minute radiating ridges. On the posterior portion of each valve of this specimen the radiating ridges are close together and not very prominent, but on the central and anterior portions they are distant and rather larger.

The dimensions of the specimen figured are as follows : maximum length, 117 mm. (or upwards of four inches and a half) : height, inclusive of either umbo, 86 mm.; greatest breadth or thickness through the closed valves, 100 mm. (or almost four inches); approximate distance between the two beaks, 33 mm.; maximum thickness of test, $5\frac{1}{2}$ mm.

"Skidegate Channel west of Alliford Bay" (and probably Maud Island) J. Richardson, 1872 : the two large casts indicated on page 73 of the first part of this volume. East end of Maud Island, G. M. Dawson, 1878, the small crushed specimen already referred to; and C. F. Newcombe, 1895, the large and testiferous specimen figured on Plate 38, and a distorted cast of the interior of another.

The specimens collected by Drs. Dawson and Newcombe show that the shape of the shell is not so different from that of the *Cucullæa* from the Nanaimo group of Vancouver and the Sucia Islands, that has been referred by the writer to *C. truncata*, Gabb, as was supposed when only the two casts collected by Mr. Richardson were available for comparison. But there are now some reasons for thinking that the specimens from the localities last mentioned may be specifically, or at any rate varietally distinct from the true *C. truncata*. Through the kindness of Prof. Pilsbry, the writer has recently been able to examine and study ten authentic examples of that species, from Cottonwood Creek, the property of the Academy of Natural Sciences of Philadelphia. The largest of these specimens, however, is only forty-nine millimetres in length, by thirty-six mm. in height, inclusive of the umbones. They seem to differ from the Maud Island specimens, and from those from Vancouver and the Sucia

Islands that have been referred to *C. truncata*, in their uniformly smaller size and more particularly in their proportionately narrower and more pointed umbones. It is just possible that the Maud Island specimens may prove to be nothing more than a large, ventricose, thick-shelled, local or stratigraphical variety of *C. truncata*, with a very broad, ligamentary area, but for the present it is thought desirable to distinguish them by a different specific name.

Modiola persistens. (N. Sp.)

Plate 37, figure 5.

Modiola, (Sp. Undt.) Whiteaves. 1876. This volume, part 1, p. 73.
Modiola subimbricata, Whiteaves. 1884. Ibid., pt. 3, p. 237. But probably not *M. subimbricata*, Meek, 1873, which is said to be a Jurassic species.

Shell of medium size, moderately elongated and slightly arched, rather strongly convex, usually higher than broad, but in one adult specimen broader than high, most prominent in each valve on the umbonal declivity (in the direction of a line that might be drawn obliquely backward and downward from the beak to the base) below and in front of which there is a shallow depression and above it a convex inflection of the valves.

Anterior side short : anterior end rounded and narrowing rapidly into the base, below the beak : posterior side much longer than the anterior and somewhat expanded vertically, highest or deepest at about the mid-length : posterior end obliquely subtruncate above, rounded and slightly produced below : ventral margin shallowly concave in some specimens but nearly straight in others : superior border gently and slightly arched, ascending gradually from the anterior end to about the midlength and then sloping gently downward : umbones depressed, beaks curved inward and forward, anterior and terminal.

Surface marked by numerous, minute and close-set, concentric striæ, also by coarser and more distant incremental lines

East end of Maud Island, C. F. Newcombe, 1895 : two well preserved but not quite perfect specimens ; besides those referred to in the first and third parts of this volume, as having been collected by Mr. Richardson and Dr. Dawson.

Melina Skidegatensis.

Melina mytiloides ? Lamarck. Whiteaves. 1876. This volume, pt. 1, pp. 80—82, figs. 8, *a-d.*
Melina Skidegatensis, Whiteaves. 1884. Ibid., pt. 3, p. 239.

East end of Maud Island, C. F. Newcombe, 1895 : an imperfect but characteristic specimen. North side of Maud Island, C. F. Newcombe, 1897 : one specimen.

Inoceramus concentricus, Parkinson.

Inoceramus concentricus, Parkinson. 1820. Trans. Geol. Soc. Lond., vol. v, p. 58, pl. 1, fig. 4.
" " Sowerby. 1821. Min. Conch., vol. III, p. 183, pl. 305: and of numerous other European palæontologists.
" " Whiteaves. 1876. This volume, pt. 1, p. 79; and (1884) pt. 3, p. 241.

Three miles north-west from Yakoun Lake, on the Rennel Sound Trail: several specimens of a large variety, with unusually coarse concentric plications, collected by Mr. Robertson in 1894,—and one fairly typical specimen collected by Mr. S. Pearse in that year; all kindly lent to the writer by Dr. Newcombe for comparison and identification.

Aucella crassicollis (Keyserling) Stanton.

Aucella Piochii, Gabb, 1869. (In part.) Geol. Surv. Calif., Palæont., vol. II, p. 194, pl. 32, figs. 92,*a–c*.
" " Whiteaves. 1882. (In part.) Trans. Royal Soc. Canada, vol. I, sect. 4, p. 84.
" " Whiteaves. 1884. This volume, pt. 3, p. 239.
Aucella concentrica (Fischer) White. 1884. Bull. U. S. Geol. Surv., No. 4, p. 13, pl. 6, figs. 2–12; and (1885) No. 15, p. 23.
Aucella Piochii, Whiteaves. 1887. (In part.) Geol. and Nat. Hist. Surv. Canada, vol. II, N.S., p. 111B.
Aucella concentrica (Fischer) White. 1889. (In part.) Mon. U. S. Geol. Surv., No. 13, p. 231, pl. 4, figs. 3-5, 11–17, and 21.
Aucella crassicollis (Keyserling) Stanton. 1896. Bull. U.S. Geol. Surv., No. 133, p. 45, pl. 5, figs. 1–13; pl. 6, figs. 1–5.

Skidegate Channel, west of Alliford Bay, J. Richardson, 1872: the specimen referred to on page 239 of the third part of this volume.

The very obscure fossil that was doubtfully referred to *Aucella Mosquensis* on pages 74 and 75 of the first part of this volume and figured on Plate 10, figs. 3 and 3 *a*, is too badly preserved and too much worn to be determined even generically. It is quite possible that it may not be an *Aucella*.

Gervillea Newcombii. (N. Sp.)

Plate 39, fig. 1.

Shell large, attaining to a maximum diameter of fully six inches, obliquely sublanceolate, about one-third longer than high, with a large broad posterior wing, and a narrow, pointed, horizontally prolonged anterior one; nearly equivalve, the right valve almost as convex as the left, very little if at all twisted, the postero-basal extremity of the left valve of the only adult specimen that the writer has seen being curved a little outward.

Anterior side consisting only of the anterior alation, which is narrow in the direction of its height or depth : posterior side widening or rather increasing rapidly in height backward : posterior end broadly, concavely and rather deeply emarginate at about the midheight, produced and apparently somewhat pointed below : posterior wing extending nearly or quite as far backward as the central portion of the valves : inferior margin forming a long oblique and broadly sigmoidal curve backward and downward from the anterior to the posterior end : cardinal margin straight, horizontal, extended, and forming the longest part of each valve : umbo and beak attenuate, the latter slightly depressed, appressed, pointing forward and placed at a short distance from the anterior end.

Surface apparently almost smooth and marked only by concentric striæ of growth. Cartilage pits numerous and well defined.

North side of Maud Island, about a quarter of a mile from Gold Harbour Village, C. F. Newcombe, 1897 : a nearly perfect cast of the interior of both valves, with a portion of the test preserved on the left valve.

The species seems to be well characterized by its peculiar shape, and more especially, by its largely developed posterior wing, by its narrowly produced anterior alation, and extended cardinal margin.

Avicula (Oxytoma) Whiteavesi, Stanton.

Oxytoma mucronata, Whiteaves. 1884. This volume, pt. 3, p. 238, pl. 31, fig. 9, and p. 251, pl. 33, figs. 6, and 6 *b* ; but not *Avicula mucronata*, Gabb, 1864, as pointed out by Dr. Stanton ; and probably not *Pteria*, or *Avicula*, *mucronata*, Meek and Hayden, 1864, which is said to be a Jurassic species.

Avicula (*Oxytoma*) *Whiteavesi*, Stanton. 1896. Bull. U. S. Geol. Surv. Terr., No. 133, p. 38, pl. 4, fig. 1.

East side of Alliford Bay, Skidegate Inlet, Dr. G. M. Dawson, 1878 : the left valve referred to on page 238 and figured on Plate 31 of the third part of this volume. Both in outline and sculpture it is remarkably similar to the shell figured as *Pteria Munsteri* on page 80 of Meek and Hayden's Palæontology of the Upper Missouri, which they suggested might be called *Pteria mucronata* or *Avicula mucronata.*

The specimens from the "Lower Sandstones" of the south side of Maud Island, that were referred to *Oxytoma mucronata* on page 251 of the third part of this volume (with the exception of the original of fig. 6 *a* on Plate 33 of the present part), are also now believed to be referable to *A. (O.) Whiteavesi.*

Dr. Stanton says that his original description of *A. Whiteavesi* was "drawn from a single specimen found with *Aucella crassicollis*, etc., in the upper part of the Knoxville beds on Shelton ranch, five miles north of Paskenta, Cal. Another left valve referred to the same species,

differing from the type in being slightly higher in proportion to its length, comes from the lower part of the Horsetown beds at Ono, Shasta County. Associated with the Ono specimen there are a number of right valves that probably belong to this species. They have about the same outline, but are much less convex; the posterior wing seems to be more narrow, and the radiating lines are so small as to be inconspicuous except under a lens."

"I think it probable," he adds, "that these fossils are identical with the form" "from the Queen Charlotte Islands that has been referred to the Jurassic *Avicula (Oxytoma) mucronata*, M. and H. Direct comparison of the California specimens with Meek and Hayden's type, which was described and figured under the name *Pteria Munsteri* (Bronn),* shows recognizable differences in both outline and sculpture. When this Jurassic form was described, the name *Pteria mucronata* was suggested for it, in case it should prove to be distinct, but, before this work appeared, Gabb had used *Avicula mucronata* for a Californian Triassic species;† consequently the name *mucronata* can not be applied to either of these species, and I name the Cretaceous form in honor of Mr. Whiteaves. A new name will also be given to the Jurassic species in another publication." (Op. cit. supra.)

In February, 1879, the specimens that have been referred to *O. mucronata* and that are figured on Plates 31 and 33 of this volume, were sent to Dr. Stanton for comparison, and in a letter dated February 15, 1889, he writes as follows in regard to them. "After careful comparisons I think that the originals of figures 6 and 6 *b* on your Plate 33 are almost certainly, and the original of fig. 9 on your Plate 31 is probably, identical with the form from the Horsetown beds that I referred to my *Avicula Whiteavesi*. But the description and figure of that species were drawn from a single specimen, from a lower horizon, and it may be the differences are really of specific importance. Besides the greater proportional height of the Horsetown specimen, it shows a greater number of radiating ribs, though that difference may be in part due to the imperfect preservation of the type of *A. Whiteavesi*, from which the shell has been exfoliated from the lower portion, where other ribs that do not reach the beaks may be intercalated."

"The sculpture of the original of fig. 6 *a* on your Plate 33 is so radically different that it seems to me impossible to refer it to the same species as the others. I should judge also that the form is quite different. "If it is like the specimen figured from Devil's Lake it is certainly different. As to its identity or otherwise with *A. Cornueliana*, judging only from

* Palæontology of the Upper Missouri, p. 80, figs. A and B in text.

† Geological Survey of California, Palæontology, vol. I, p. 30, pl. 5, fig. 27.

the figures given by d'Orbigny and Pictet, I should say that on your specimen the interspaces between the principal ribs are flatter and bear more nearly equal, finer and much more numerous radiating striæ. The concentric sculpture is also apparently much less distinct."

In this connection it may be said that the reference of the Devil's Lake specimens to the *A. Cornueliana* of the French and Swiss Neocomian has has not proved satisfactory, and it will be convenient to designate the former by the new specific name *Avicula (Oxytoma) McConnelli*, in honour of their discoverer. The Maud Island specimen represented by fig. 6 *a* of Plate 33 is probably specifically identical with *A. McConnelli*, but is much too imperfect to admit of a satisfactory comparison with the types of that species.

Pecten Meekanus.

Syncyclonema Meekiana, Whiteaves. 1876. This volume, pt. 1, p. 82, fig. 9.

East end of Maud Island, two specimens ; and south side of Alliford Bay, one specimen : C. F. Newcombe, 1895.

Gryphæa persimilis. (Nom. prov.)

Gryphœa Nebrascensis, Whiteaves. 1884. This volume, pt. 3, p. 244, pl. 32, figs. 2 and 2, *a-b*. But apparently not *G. calceola*, var. *Nebrascensis*, Meek & Hayden, 1861, which is said to be a Jurassic species.

Shell of medium size, variable in shape but usually irregularly elongate subovate or ovately subtriangular : front margin, or inferior border, often unequally bilobate. Lower valve deep, either uniformly convex, or impressed with a comparatively distinct submedian longitudinal sulcus, so that the front margin is concavely sinuated near the middle, lobate on both sides, somewhat elongated or produced anteriorly,—and sometimes with a much fainter, lateral and presumably anterior but otherwise somewhat similar sulcus. Umbonal region of the lower valve tumid, the umbo itself strongly incurved, the beak acute and entire in some specimens, but truncated and showing a small scar of attachment in others. Upper valve small, concave externally, with comparatively inconspicuous umbo and beak. Cardinal area not clearly exposed in any of the specimens that the writer has seen.

Surface of some specimens marked only by numerous and closely disposed concentric lines of growth, but in others the umbo of the lower or convex valve is marked also by numerous and equally closely disposed, small, irregular and subparallel, longitudinal raised lines. Hinge dentition and muscular impressions unknown.

Maximum length of the largest specimen that the writer has seen, sixty-eight millimetres.

The specimens from Maud Island and Alliford Bay collected by Dr. G. M. Dawson in 1878 and referred to on page 245 of the third part of this volume, are the only ones known to the writer. In the American Journal of Science for March, 1885, Dr. C. A. White has expressed the opinion that these specimens are more like *Gryphæa navia*, Conrad, than *G. Nebrascensis*, but the lower valve of *G. navia* is said to have a narrowly subtrigonal outline, an angular umbo, and a sharp umbonal ridge.

Anomia Linensis. (N. Sp.)

Plate 39, fig. 2.

Upper valve (the only one known to the writer) almost flat, but slightly convex in the umbonal region, subcircular but rather irregular in outline, beak small, flattened obliquely downward, and nearly but not quite marginal.

Surface marked by numerous closely arranged and slightly flexuous, radiating raised lines or minute ridges, which are crossed and somewhat interrupted by lines of growth and concentric wrinkles.

Maximum length of one of the best specimens, twenty-seven millimetres; greatest breadth practically the same.

Lina Island, C. F. Newcombe, 1897: three well preserved moulds of the exterior of upper valves, on a cast of the interior of the shell of *Cyprina occidentalis*. The figure and the foregoing description are taken from a gutta percha impression of one of these moulds.

Brachiopoda.

Terebratula Skidegatensis. (Nom. prov.)

Plate 37, figs. 6 and 6 *a*.

Terebratula (?) Sp. undt. Whiteaves. 1876. This volume, pt. 1, p. 83.

Perhaps a var. of *T. subdepressa*, Stoliczka.

Cfr. *Terebratula subdepressa*, Stoliczka. 1872. Cret. Brachiop. S. India, p. 16, pl. 2, figs. 9-16, and pl. 3, figs. 1-8.

Cfr. *Terebratula robusta*, Whiteaves. 1889. Contr. Canad. Palæont., vol. I., pt. 2, p. 163, pl. 22, figs. 1, 1, *a-b*, and 2.

Amended description.—Shell rather large, subovate, broader than long, and broadest at about the midlength, sometimes obtusely pointed in front, when adult, but fully as broad as long when not quite full grown: front margin nearly or quite straight, with no distinct fold or sinus.

Ventral valve moderately convex, most prominent in the middle longitudinally, and sloping rapidly downward and outward on each side, its umbo and beak prominent and lightly incurved, the latter truncated and widely perforated: foramen large, circular: deltidium apparently very short and rather wide, but not well shown in any of the specimens that the writer has seen. Dorsal valve flatter, with a much smaller and less prominent umbo and beak than that of the ventral.

Surface marked by fine concentric striæ of growth. On the umbonal region of the dorsal valve of one specimen, also, there are remains of minute radiating striæ. Lower layer of the test minutely and densely punctate. Muscular scars of the dorsal valve elongated and narrow, those of the ventral valve unknown. Loop and hinge dentition also unknown.

Dimensions of the largest specimen collected: greatest length about fifty-six millimetres; maximum breadth, forty-nine mm.; greatest thickness through the closed valves, twenty-eight mm.

East end of Maud Island, C. F. Newcombe, 1895: a slightly distorted cast of the interior of both valves, with portions of the test preserved and showing the muscular impressions on the dorsal valve. North side of Maud Island, C. F. Newcombe, 1897: a cast of the interior of a ventral valve with a small piece of the test preserved. These and the two (not three) "broken and badly preserved specimens" described on page 84 of the first part of this volume, which are probably also from Maud Island, are all that the writer has seen.

Rhynchonella obesula. (N. Sp.)

Plate 39, figs. 3, 3 *a*, and 4.

(?) *Terebratella obesa* (Gabb), Whiteaves. 1884. This volume, part 3, p. 245.

Shell transversely subelliptical, much broader than long and rather strongly convex when adult, but ovately subtriangular, fully as high as broad and flatter when young,—with no distinct fold or sinus. Umbo and beak of the ventral valve moderately prominent, its hinge area unknown: umbo of the dorsal valve much less prominent, its beak strongly incurved.

Surface of each valve marked with from twelve to sixteen comparatively large and sharply angular, radiating ribs, with two or three smaller and much less distinct ones on each side. Hinge dentition and muscular impressions unknown.

South side of Alliford Bay,—and north side of Maud Island, Dr. G. M. Dawson, 1878: the specimens doubtfully referred to *Terebratella obesa*,

Gabb, on pages 245 and 246 of the third part of this volume. South side of Alliford Bay, C. F. Newcombe, 1895 : a crushed specimen, about twenty-six millimetres in breadth, and showing the characters of the thin, sharp ribs better than any of those that had previously been collected.

It is doubtful whether these specimens should be regarded as representing a small, local and stratigraphical variety of the "*Terebratella obesa*" of Gabb, from the Chico Group of California, (which is probably a *Rhynchonella*) or as a distinct and previously undescribed species. Professor John C. Merriam, who has kindly compared them with the types of that species in the Museum of the University of California, at Berkeley, writes as follows, in regard to this point, in a letter dated October 17th, 1898. "I would not like to form a definite opinion without seeing some more perfect material, but may say that I doubt whether your specimens are *T. obesa*. *T. obesa* is somewhat different in form and seems uniformly to possess more ribs than your specimens. I think our specimen of *T. obesa* has about ten more ribs than the largest specimen among those which you sent.

"*T. obesa* seems to me to be a *Rhynchonella*. The type has on some parts numerous pits, but they are very large and irregular. I think they are formed by some borer, perhaps an unknown sponge. The pits are at any rate quite different from those of the terebratuloids.

"Mr. F. M. Anderson, who is working in Cretaceous palæontology here, has just examined these Rhynchonellæ from Skidegate Inlet, and agrees with me that it is safer not to call them *obesa*. He thinks the form is different and suggests that your specimens represent a smaller species than *obesa*, which even in young forms seems to have more ribs than your species. He suggests also that your specimens are from the Horsetown, while *obesa* is from the Chico."

Under all the circumstances it seems most prudent to distinguish these rather coarsely ribbed Rhynchonellæ from the Lower Shales of the Queen Charlotte Islands, at least provisionally, by a different and new specific name.

Rhynchonella orthidioides. (N. Sp.)

Plate 39, fig. 5.

Shell small, compressed, transversely subelliptical and a little broader than long; front margin slightly curved in the middle but apparently devoid of a distinct fold or sinus. Ventral valve flattened somewhat obliquely, with a faint shallow depression at the midbreadth in front, its umbo rather narrow and moderately prominent : dorsal valve uniformly compressed convex, rather more convex than the ventral, beak of the dorsal incurved.

Surface marked by numerous, very small and close set, radiating ribs. Counting the smallest on each side, that can scarcely be seen without the aid of a lens, there are about forty of these ribs on each valve. Hinge dentition and muscular impressions unknown.

Dimensions of the only specimen that the writer has seen: length, inclusive of the beak, about nine millimetres; maximum breadth, not quite twelve mm.; greatest thickness, four mm.

East end of Maud Island, C. F. Newcombe, 1895: a well preserved cast of the interior of both valves, with portions of the inner layer of the test adherent thereto, but with a small piece of one side of the umbo and beak of the ventral valve broken off. In general appearance this little shell is not unlike a small and finely ribbed *Orthis*, but it may not be quite full grown. It has almost the same marginal outline as the *Terebratella Californica* of Stanton,* from the Knoxville beds of California, but that species appears to be a true terebratuloid, with a minutely punctate structure and the beak of the ventral "truncated by the large round foramen."

CŒLENTERATA.

Astrocænia irregularis, Whiteaves.

Astrocœnia irregularis, Whiteaves. 1884. This volume, part 3, p. 246, pl. 33, fig. 1.

In 1897 Dr. Newcombe found a reef of this species about a quarter of a mile from Gold Harbour Village, on the north shore of Maud Island, and has since presented a small piece broken from it to the Museum of the Survey.

* Bulletin U. S. Geological Survey, No. 133, p. 33, pl. 1, figs. 12 and 13.

List of fossils from the Cretaceous rocks of the Queen Charlotte Islands.*

1. From the "Upper Shales and Sandstones," or Subdivision A of Dr. G. M. Dawson's Report.

Inoceramus labiatus, Schlotheim.
(=I problematicus, Schloth., et auct.)

2. From the "Coarse Conglomerates," or Subdivision B of Dr. Dawson's Report.

Fragment of guard of Belemnite, species indeterminable.

3. From the "Lower Shales and Sandstones," or Subdivision C of Dr. Dawson's Report.

FISHES.

Scales of a small teleost.

CRUSTACEA.

DECAPODA.

Homolopsis Richardsoni, H. Woodward.

MOLLUSCA.

CEPHALOPODA.

Phylloteuthis incertus.
Belemnites assimilis.
" Skidegatensis.
Nautilus (Cymatoceras) Carlottensis.
Phylloceras Knoxvillense, Stanton. Var.
Lytoceras Batesii (Trask).
Lytoceras (Gaudryceras) Sacya (Forbes).
Lytoceras (Tetragonites) Timotheanum (Mayor).
Turrilites Carlottensis.
Turrilites (species indeterminable).
Hamites (Ptychoceras) glaber.
Hamites (species indeterminable.)
Diptychoceras (species indeterminable).
Schloenbachia inflata (Sowerby).
Acanthoceras spiniferum.
Olcostephanus Richardsoni.
" Loganianus.
Olcostephanus cepoides.
" oblatum.
" (Astieria) Deansii
Perisphinctes Carlottensis.
" Skidegatensis.
Holcodiscus Laperousianus.
" Cumshewaensis.
Hoplites Haidaquensis.
" Yakounensis.
" Newcombii.
Desmoceras latidorsatum (Michelin).
Desmoceras (Puzozia) planulatum (Sowerby).
" " Perezianum.
" " Dawsoni.
" " Brewerii (Gabb.)
" " Maudense.
Ancyloceras Remondi, Gabb.

*All the species for which no author's name is given, have either been or are here described by the writer.

GASTEROPODA.

Pleurotomaria Skidegatensis.
Calliostoma constrictum.
Scalaria Clementina, (Michelin) d'Orbigny.
Vanikoro pulchella.
Amauropsis tenuistriata.
Pseudomelania (species indeterminable).
Nerinæa Maudensis.
Cerithium Skidegatense.
Trochactæon cylindraceus ? Stoliczka.
Cinulia pusilla.

PELECYPODA.

Teredo Suciensis.
Martesia carinifera.
Corbula concinna.
Thracia semiplanata.
Anatina (Cercomya) semiradiata.
Pleuromya papyracea, var. Carlottensis.
Pleuromya lævigata.
Goniomya (species indeterminable).
Pholadomya ovuloides.
Tellina Skidegatensis.
Cytherea (Caryatis) subtrigona.
Thetis affinis.
Cyprina occidentalis.
Protocardia subsimile.
Astarte Carlottensis.
Unio Hubbardi, Gabb.
Trigonia Tryoniana ? Gabb.
" diversicostata.
" Dawsoni.
" Maudensis.
Meekia sella, Gabb.
Yoldia arata.
Nucula solitaria ? Gabb.
Nucula (Acila) truncata, Gabb.
Arca (Nemodon) simillima.
Arca (Nemodon) Cumshewaensis.
Trigonoarca tumida.
Cucullæa ponderosa.
Lithodomus Maudensis.
Modiola persistens.
Mytilus lanceolatus ? J. Sowerby.
Melina Skidegatensis.
Inoceramus Moresbyanus.
" concentricus, Parkinson.
" (Actinoceramus) sulcatus, Parkinson.
Aucella crassicollis (Keyserling) Stanton.
Gervillia Newcombii.
Meleagrina amygdaloidea.
Avicula (Oxytoma) Whiteavesi, Stanton.
Pecten Meekanus.
Pecten (Entolium) lenticularis.
(=Amusium lenticulare, W.)
Camptonectes curvatus ? Geinitz.
Gryphæa persimilis.
Ostrea Skidegatensis.
Anomia Linensis.

MOLLUSCOIDEA.

BRACHIOPODA.

Terebratula Skidegatensis.
Rhynchonella obesula.
Rhynchonella orthidioides.

CŒLENTERATA.

ANTHOZOA.

Astrocænia irregularis.

4. From the "Agglomerates," or Subdivision D of Dr. Dawson's Report.

Three undeterminable fragments, apparently of the shells of pelecypoda, one of which looks like a piece of the exfoliated valve of an *Ostrea*.

5. From the "Lower Sandstones," or Subdivision E of Dr. Dawson's Report.

CEPHALOPODA.

Schloenbachia propinqua.
Sphenodiscus Requienianus? D'Orbigny.

GASTEROPODA.

Pleurotomaria Skidegatensis.
Cinulia (species indeterminable).

PELECYPODA.

Pleuromya lævigata?
Cardium tumidulum.
Protocardia (species indeterminable).
Avicula (Oxytoma) Whiteavesi, Stanton.
Avicula (Oxytoma) McConnelli?
Lima (species indeterminable).
Pecten Carlottensis.

BRACHIOPODA.

Rhynchonella Maudensis.
Discina (?) semipolita.

Ottawa, March, 1899.

PLATE XXXIII.

(With the exception of the coral (fig. 1), all the fossils represented on this Plate, are from the Lower Sandstones of the south side of Maud Island).

ASTROCÆNIA IRREGULARIS (page 246).

Figure 1. Calicular surface of a portion of a colony, drawn from a gutta percha squeeze of a specimen from the Lower Shales at Maud Island.

SCHLOENBACHIA PROPINQUA (page 247).

Figure 2. Side view of the largest entire specimen collected.
" 2 *a*. Outline of aperture of the same.
" 2 *b*. Side view of a smaller but better preserved specimen.
" 2 *c*. Similar view of a large fragment.

PLEUROMYA LÆVIGATA (pages 249 and 289).

Figure 3. Side view of the most perfect specimen yet collected from the Lower Sandstones.

CARDIUM TUMIDULUM (page 249).

Figure 4. Side view of a specimen, slightly enlarged.
" 4 *a*. Similar view of another specimen.

PROTOCARDIUM; species undeterminable (page 250).

Figure 5. Side view of the specimen referred to on page 250, shewing the left valve.

AVICULA (OXYTOMA) WHITEAVESI (page 298).

(The *Oxytoma mucronata* of page 251.)

Figure 6. Side view of an imperfect left valve.
" 6 *b*. Similar view of a perfect right valve.

AVICULA (OXYTOMA) MCCONNELLI (page 300).

Figure 6 *a*. An imperfect left valve, that is doubtfully referred to this species.

PECTEN CARLOTTENSIS (page 251).

Figure 7. One of the most perfect specimens collected (which, however, wants both ears) with a small piece of the test about twice the natural size, to show the surface ornamentation.

RHYNCHONELLA MAUDENSIS (page 252).

Figure 8. Dorsal view of a perfect specimen.
" 8 *a*. Front view of the same.
" 8 *b*. Ventral view of the same.

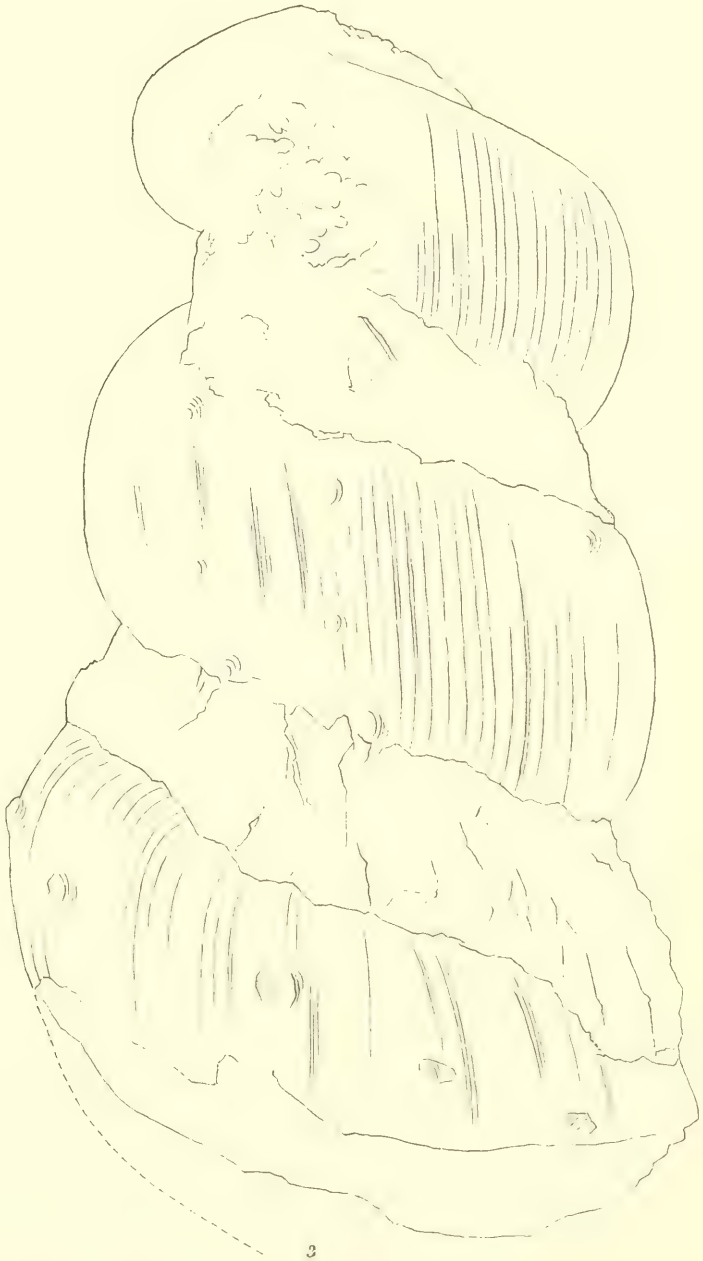
DISCINA SEMIPOLITA (page 252).

Figure 9. Upper valve of a specimen with the test preserved, slightly enlarged.
" 9 *a*. Imperfect cast of the interior of another upper valve, shewing part of the muscular impression, and slightly enlarged.

PLATE XXXIV.

TURRILITES CARLOTTENSIS (page 271).

The fine specimen from Bear Skin Bay referred to in the text, three-fourths of the natural size, and in outline only.



$\frac{3}{4}$

PLATE XXXV.

PHYLLOTEUTHIS INCERTUS (page 268).

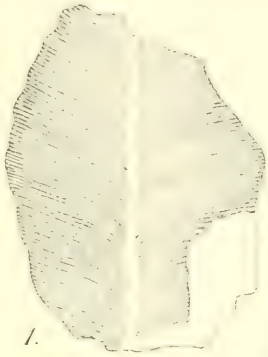
Figure 1. The only specimen collected.

ACANTHOCERAS SPINIFERUM (page 273).

Figure 2. Side view of the largest specimen yet collected, two-thirds the natural size.

" 3. Side view of a small but very perfect specimen, of the natural size.

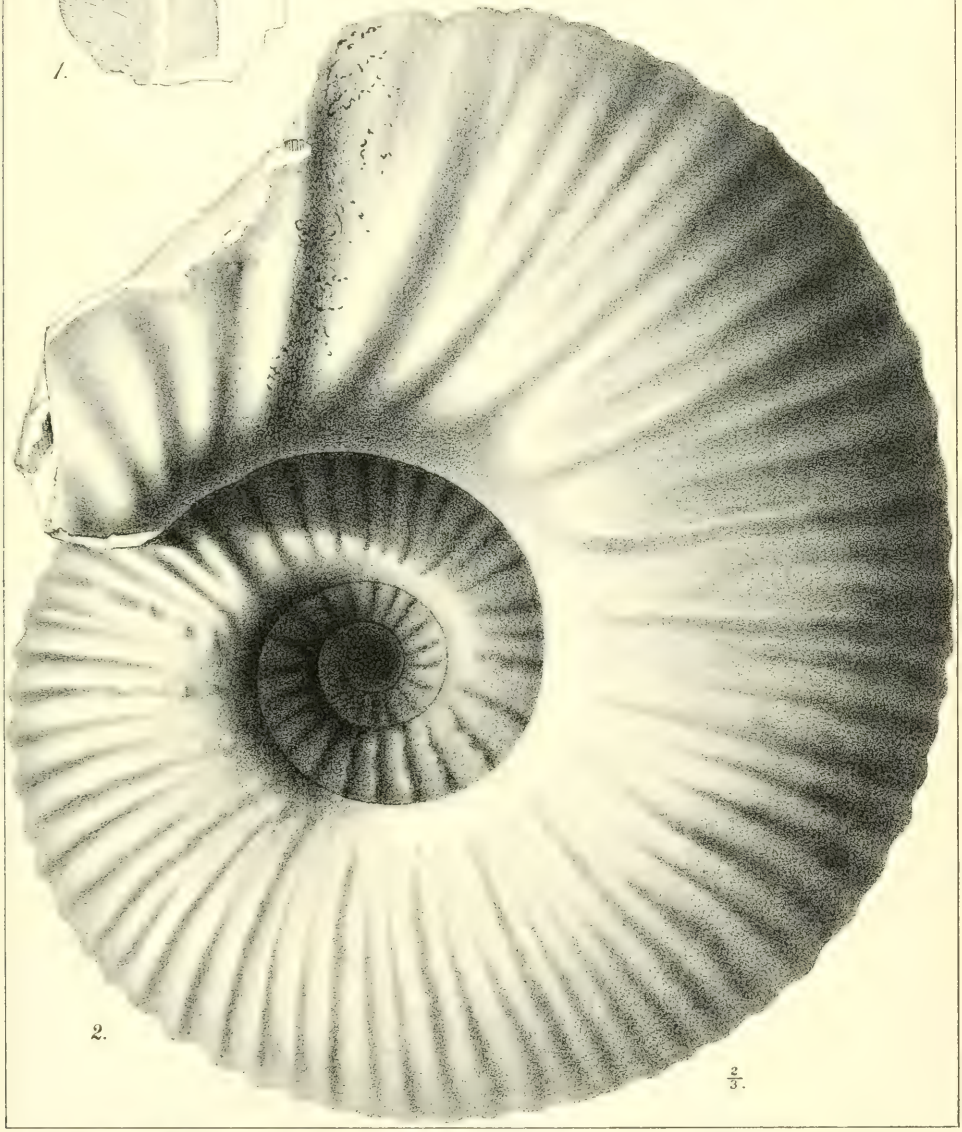
" 3 *a*. Ventral view of the same.



1.

3a.

3.



2.

$\frac{2}{3}$.

PLATE XXXVI.

HOPLITES YAKOUNENSIS (page 280).

Figure 1. Side view of the specimen fron the east end of Maud Island, referred to in the text.

" 1 *a*. Ventral view of the same.

" 1 *b*. Outline of aperture of the same.

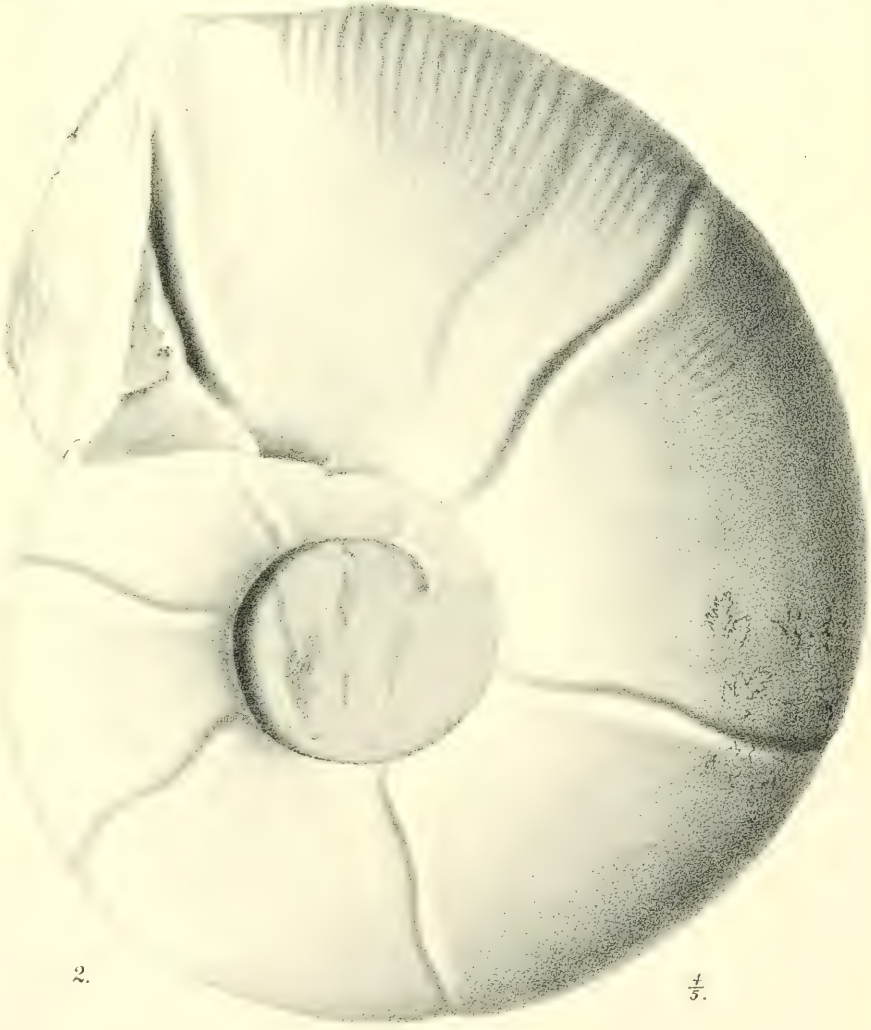
DESMOCERAS (PUZOZIA) PLANULATUM ? var. (page 282).

Figure 2. Side view of the more perfect of the two specimens from Maple Island, described in the text, four-fifths the natural size.

1.

1b.

1a.



2.

$\frac{4}{5}$.

PLATE XXXVII.

HOPLITES NEWCOMBII (page 281).

Figure 1. Side view of the type of this species.

" 1 *a*. Ventral aspect of the same.

DESMOCERAS (PUZOZIA) PLANULATUM? var. (page 282).

Figure 2. Apertural view, in outline, of the specimen figured on Plate xxxvi, fig. 2, four-fifths of the natural size.

DESMOCERAS (PUZOZIA) Dawsoni (page 286).

Figure 3. Apertural view, in outline, of a specimen from the north shore of Cumshewa Inlet, collected by Dr. Dawson in 1878.

ANATINA (CERCOMYA) SEMIRADIATA (page 288).

Figure 4. Side view of a specimen from Maud Island, shewing the right valve.

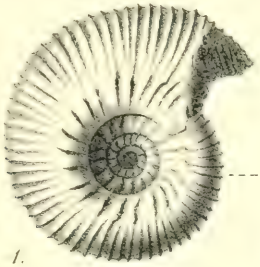
MODIOLA PERSISTENS (page 296).

Figure 5. Side view of a specimen from the east end of Maud Island, slightly restored, and shewing the right valve.

TEREBRATULA SKIDEGATENSIS (page 301).

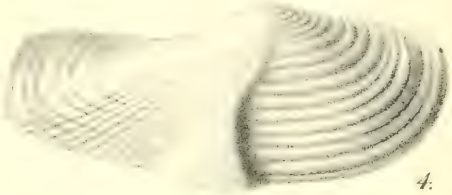
Figure 6. Dorsal view of a specimen from Maud Island, collected by Dr. Newcombe.

" 6 *a*. Profile view of the same.



1.

1a.



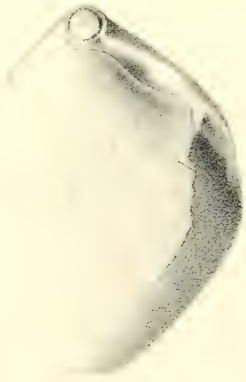
4.

5.

$\frac{4}{5}$.

2.

6a.



6.

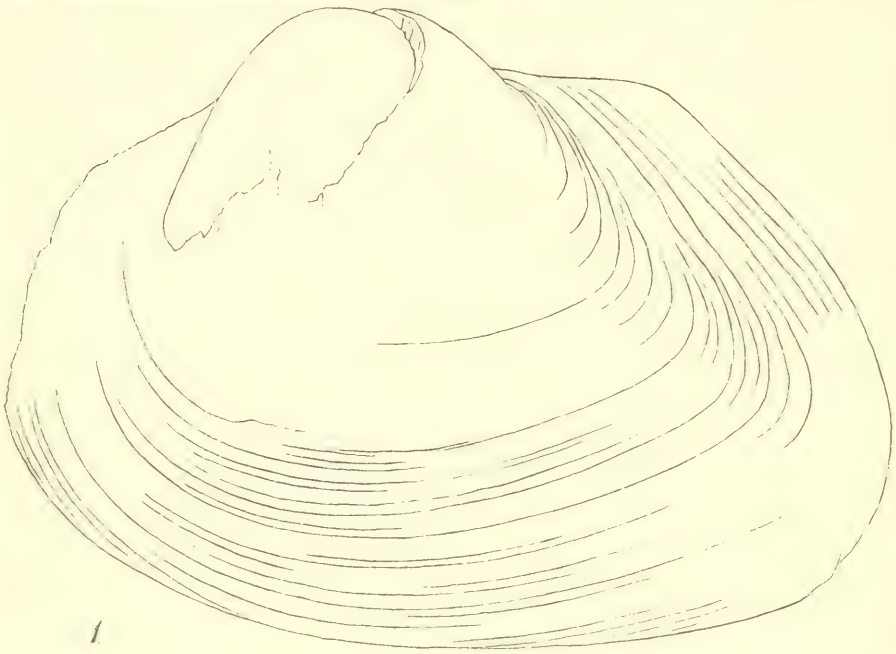
3.

PLATE XXXVIII.

CUCULLÆA PONDEROSA (page 294).

Figure 1. Side view, in outline, of the large and testiferous specimen from the east end of Maud Island, collected by Dr. Newcombe, and referred to in the text.

" 1 *a*. The same, also in outline, as seen from above, to show the breadth of the specimen, and the proportionate size of the large cardinal area.



1

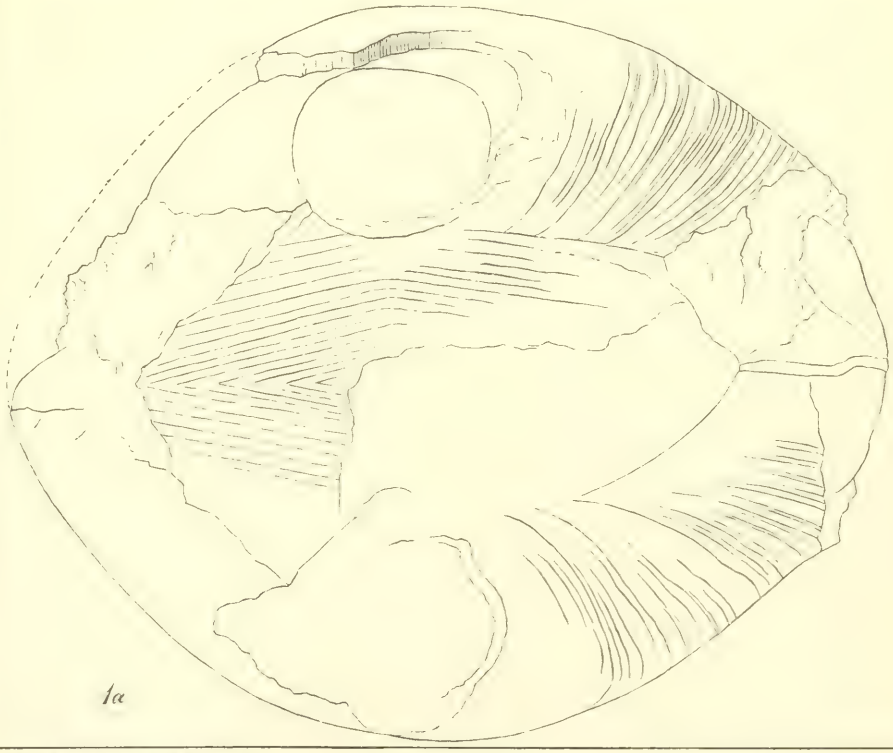


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PLATE XXXIX.

GERVILLEA NEWCOMBII (page 297).

Figure 1. Side view of the type of this species, showing the left valve.

ANOMIA LINENSIS (page 301).

Figure 2. Upper valve, drawn from a gutta percha squeeze of a natural mould of that valve, from Lina Island.

RHYNCHONELLA OBESULA (page 302).

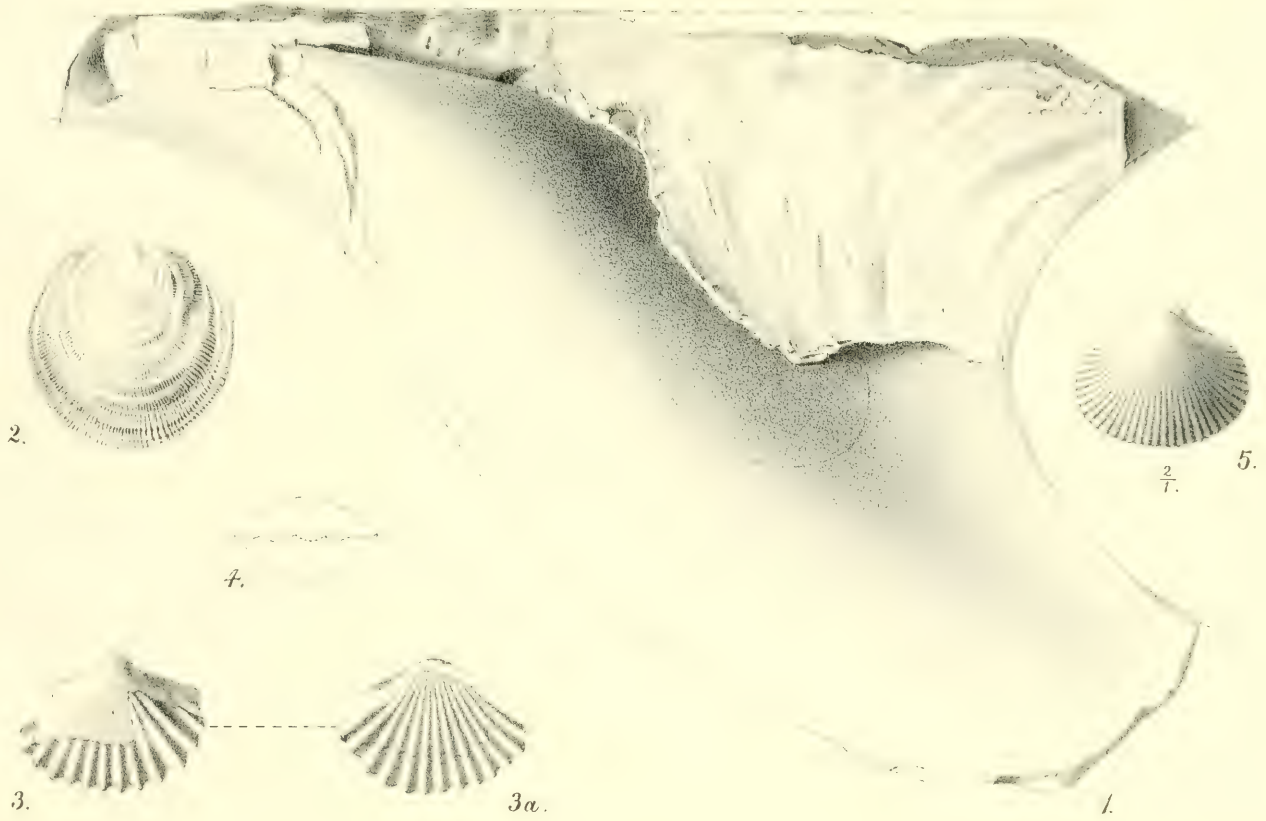
Figure 3. Ventral view of a nearly perfect but crushed specimen, from the south side of Alliford Bay, collected by Dr. Newcombe.

" 3 *a*. Dorsal view of the same.

" 4. Outline of an undistorted but imperfect specimen, which shows the relative convexity of the two valves as seen from above. In this specimen both of the beaks have been worn away by exposure.

RHYNCHONELLA ORTHIDIOIDES (page 303).

Figure 5. Dorsal view of the only specimen known to the writer, twice the natural size.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GEOLOGICAL SURVEY OF CANADA.

MESOZOIC FOSSILS.

10,039

BY J. F. WHITEAVES.

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VOLUME I.

V.—On some additional fossils from the Vancouver Cretaceous, with a revised list of the species therefrom.

Prefatory Remarks.

The second part of this volume, which was published in 1879, consists of a descriptive and illustrated Report on the fossils of the Cretaceous rocks of Vancouver and the adjacent islands, collected by the late Mr. James Richardson, in the years 1871-1875, both included.

The present publication is a similar Report on the many collections of fossils from these rocks that have been received and studied since 1879, but more particularly during the last thirteen years. These collections may be briefly indicated as follows :—

Vancouver Island.—Fossils collected on the Puntledge River, near Comox, by the Rev. G. W. Taylor in 1889, by Mr. Walter Harvey in 1891 and 1892, by Dr. C. F. Newcombe in 1892, and by Mr. J. B. Bennett in 1895 and 1896 ; at North West Bay by Mr. Harvey in 1897 ; on the Nanaimo River, and at several localities near Nanaimo, by Mr. Harvey in 1901 ; and at Brennan Creek, near Wellington, by the Rev. G. W. Taylor in 1901. Brennan Creek, it may be mentioned, is two miles from Wellington. It runs, Mr. Taylor states, from the northern spur of Mount Benson, into Brennan Lake.

Denman Island.—Fossils collected by Mr. Harvey in 1892, 1893, 1895 and 1896.

Hornby Island.—Fossils collected by Mr. Harvey in 1892-95, by Dr. Newcombe in 1892, by Dr. Beadnell in 1895, by Mr. Robbins in 1893, 1895 and 1896, and by Mr. Bennett in 1896 and 1898.

Texada Island.—One species of fossil brachiopoda and sixteen species of fossil mollusca from a small outlier of Cretaceous rocks discovered by Mr. Harvey in 1901, at the south-eastern end of the island, about half a mile from the beach, on the two south branches of a small creek emptying into Bull Passage, the channel between Texada and Lasqueti islands, opposite the most northerly point of the most northerly island forming the protection to Tucker Bay, on Lasqueti, and about five miles, or perhaps more, from the south end of Texada. The only Cretaceous fossils that had previously been obtained from this island are a few fossil plants from Gillies Bay, collected by Mr. Richardson in 1873.

Lasqueti Island.—Small collections of fossils made by Mr. Harvey in 1896 and 1901.

Sucia Islands.—Numerous fossils collected at these islands by Dr. Newcombe in 1894 and 1896.

For the opportunity of examining and studying these specimens, many of which have been presented to the Museum of the Survey, the writer is much obliged to the senders, especially to Mr. Harvey, to Dr. Newcombe, and the Rev. G. W. Taylor, for the many interesting fossils that they have so kindly forwarded.

Captain Palliser's Vancouver Island Fossils.—In 1896, the Geological Society of London, through its president, Dr. Henry Woodward, kindly lent to the writer all the Cretaceous fossils obtained at Vancouver Island in 1860 by Sir J. W. Hector, during Captain Palliser's explorations, that were then at Burlington House.

Fossils from the Provincial Museum at Victoria.—All the local Cretaceous fossils from this Museum, including many fine specimens collected at Hornby and Denman islands by Mr. Harvey in 1892, have also been kindly lent to the writer by its curator, Mr. John Fannin.

Since 1879, the following papers have been published on the Vancouver Cretaceous and its fossils.

1889.

Cretaceous Fossils from Vancouver Island Region.

By Dr. C. A. White.

Bulletin of the U. S. Geological Survey, No. 51, Part 3, pp. 33-48, pls. VI and VII.

This paper is based upon fossils from Sucia, Waldron and Sheep Jack* islands, received from Dr. Newberry, many of which are stated to have been collected by Mr. E. W. McClure. Three new species, viz., *Perna excavata*, *Vanikoropsis Suciensis*, and *Ammonites Maclurei*, are described and figured.

*Dr. Newcombe says that this last name should be written Skip Jack.

1890

Notes on the Cretaceous of the British Columbia Region.

The Nanaimo Group.

By Dr. G. M. Dawson.

American Journal of Science for March, 1900, Third Series, vol. xxxix, pp. 180-183.

The "Nanaimo group" is here proposed as a "local name for the equivalent of the Chico group in the Vancouver Island region." It is defined as including the lower subdivisions A and B of Mr. Richardson's Nanaimo section, and A, B, C and D of his Comox section, as quoted on page 94 of the second part of this volume. The suggestion is also made that some at least of the higher subdivisions of these sections may represent the Tejon group of California, or the Puget group of the Puget Sound region.

1893.

Presidential Address: the Cretaceous System in Canada.

By J. F. Whiteaves.

Transactions of the Royal Society of Canada for 1893, Series I, vol. xi, section iv, pp. 3-19. Separate copies distributed November, 1893.

Includes some general remarks and conclusions in regard to the Vancouver Cretaceous.

1895.

Notes on some fossils from the Cretaceous rocks of British Columbia, with descriptions of two species that appear to be new.

By J. F. Whiteaves.

Canadian Record of Science for April, 1895, vol. vi, pp. 313-317, pl. ii.

The supposed new species are *Heteroceras Hornbyense* and *H. perversum*.

1896.

Note on some of the Cretaceous fossils collected during Captain Palliser's explorations in British America in 1857-60.

By J. F. Whiteaves.

Transactions of the Royal Society of Canada for 1895, Second Series, vol. I, section iv, pp. 101-117, pl. I.

1896.

On some Fossils from the Nanaimo group of the Vancouver Cretaceous.

By J. F. Whiteaves.

Idem, pp. 119-136, pls. II and III.

1896.

On some Podophthalmatous Crustacea from the Cretaceous Formation of Vancouver and Queen Charlotte Islands.

By Henry Woodward, LL.D., F.R.S., F.G.S.

Quarterly Journal of the Geological Society of London for May, 1896, vol. liii, pp. 221-228, with six woodcuts in the text.

1900.

Further notes on Podophthalmatous Crustaceans from the Upper Cretaceous Formation of British Columbia, etc.

By Henry Woodward, LL.D., F.R.S., F.G.S.

Two papers, published in the Geological Magazine for September and October, 1900, Decade IV, vol. VII, pp. 392-401, and 433-435, pls. XV, XVI and XVII.

1901.

Description of a new species of *Unio* from the Cretaceous Rocks of the Nanaimo Coal-Field, V.I.

By J. F. Whiteaves.

Ottawa Naturalist, January, 1901, vol. XIV, No. 10, pp. 177-179, figs. 1 and 1*a*.

The *Unio* is *U. Nanaimoensis.*

It was in 1869, in the second volume of the Palæontology of California, that Professor J. D. Whitney and Mr. W. Gabb first correlated the coal-bearing formation of Vancouver, which Dr. Dawson has called the Nanaimo group, with the Chico group of California. All the fossils enumerated or described in Part II., and in the present part of this volume, are from the Nanaimo group, which, as now understood, would appear to be not only the equivalent of the Chico group, but also of the Pierre-Fox Hills or Montana formation of Manitoba, the North-west Territories and the Upper Missouri County; also, in a general way, of the Upper Chalk of England and the Senonian of France. Dr. Kossmat correlates it with the Upper Senonian.

The fossil fauna of of the Nanaimo group, also, is strikingly similar to that of the higher beds of the Upper Cretaceous in the Island of Saghalien (Sachalin) in the Sea of Okhotsk, of Japan and Southern India. As a whole, its fauna is quite different to that of the somewhat older Cretaceous rocks of the Queen Charlotte Islands, though a few species appear to be common to both. These latter are,—an Ammonite that can scarcely be distinguished from *Tetragonites Timotheanus*; *Vanikoro pulchella*; *Nucula (Acila) truncata*; and perhaps *Trigonia Tryoniana*. *Phylloceras ramosum* and *Cucullæa truncata* of the Nanaimo group, also, are very nearly allied to *P. Knoxvillense* and *C. ponderosa* of the Queen Charlotte Island Cretaceous.

Some thin shaly beds of the Vancouver Cretaceous contain the remains of land plants, which have been described elsewhere by the late Sir J. W. Dawson and others, but the fauna of the Nanaimo group would seem to be almost exclusively marine. The only indications of land or fresh-water shells in these rocks that the writer has seen, are the type of *Unio Nanaimoensis*, from the Wellington mine, near Nanaimo, and six very imperfect specimens of a gasteropod, that is possibly not marine, from the roof of the coal at the Nanaimo mines. The following are some of

the most striking features of this fauna, as indicated by the collections received since 1879 :—

1. *Fishes.* Indications of a true teleost, and of at least one species of Selachii.

2. *Crustacea.* The comparatively large number of species of Decapoda, nine of which have recently been described by Dr. Henry Woodward.

3. *Ammonitidæ.* An unusually large development of the genus *Pachydiscus*, both in specimens and in species. Not less than eight species of this genus are either enumerated or described in these pages. Curiously enough, no species of *Pachydiscus* has yet been discovered in the Cretaceous rocks of the Queen Charlotte Islands, though it is difficult to see what generic distinction there is between the *Pachydiscus Newberryanus* of the Vancouver, and the *Desmoceras planulatum* of the Queen Charlotte Island Cretaceous. Specimens of a species of *Baculites* are common in the Nanaimo group, but no Baculites have as yet been found in the Queen Charlotte Island Cretaceous.

4. *Gasteropoda.* The occurrence of a small smooth species of *Cyprœa*; of three large species that are probably referable to Deshayes' genus *Mesostoma*; of a *Solariella* that is scarcely distinct from the *S. radiatula* (Forbes) of the Cretaceous rocks of Saghalien and Southern India; and of a large limpet-like shell that is probably only a variety of the *Helcion giganteus* of the Saghalien Cretaceous.

5. *Pelecypoda.* The discovery of a *Unio* that is apparently distinct from the *U. Hubbardi*, Gabb, of the Queen Charlotte Island Cretaceous, and a considerable reduction in the number of species of *Inoceramus*, both the supposed *I. undulatoplicatus* of Rœmer and *I. mytilopsis* of Conrad being now regarded as forms of *I. digitatus* (Sowerby) Schmidt, from the Cretaceous of Texas, Saghalien and Nebraska.

In 1896, ten specimens and six photographs of various species of Ammonites, mostly critical species of *Pachydiscus*, from the Nanaimo group, were sent to Dr. Franz Kossmat, of Vienna, for direct comparison with certain species from Southern India, and Europe. Some interesting notes upon each of these specimens have been kindly communicated by Dr. Kossmat, and, with his permission, most of these notes are here quoted in full, in their proper place in these pages.

The writer, also, is greatly indebted to Dr. T. W. Stanton, of the U.S. Geological Survey, for comparing several critical fossils from the Nanaimo group, with Californian specimens in the U. S. National Museum; and to Mr. F. M. Anderson, for comparing fossils from the Vancouver Cretaceous, with some of Mr. Gabb's types and other specimens in the Geological Museum of the University of California at Berkeley.

Determinations and Descriptions of Species.

FISHES.

Teleostei.

Very few remains of fishes appear to have been collected from the Vancouver Cretaceous. The only indications of teleosts in these rocks that the writer has seen, are portions of some small, deeply biconcave vertebræ, with long transverse processes, in two fragments of a concretionary nodule from Hornby Island, collected by Mr. Harvey in 1894. Dr. A. Smith Woodward, who has kindly examined these specimens, writes as follows in regard to them, in a letter dated April 28, 1896 :— "The group of small vertebræ, with very large transverse processes, and completely pierced by the notochord, probably belongs to a member of the Hoplopleuridæ (Dercetidæ). I do not know of any other Cretaceous vertebræ of the same kind."

Selachii (Elasmobranchii).

Asterospondylic Vertebra.

(Genus and species unknown).

Plate 44, fig. 1.

A small concretionary nodule from the Puntledge or Comox River, V. I., collected by Mr. Harvey in 1892, proves to be formed around the calcified centrum of one of the vertebræ of a Selachian. This centrum, which is shallowly biconcave, is a little over an inch in diameter, and marked by numerous close-set, annular striæ. It had such a distinctly X-shaped cleavage, that, when the nodule containing it was broken, the centrum separated into four flattened four-sided pyramids, which fit closely together, with their apices inward. Natural casts of either of the concave surfaces of this centrum are singularly like the upper valve of a *Discina*, and prove to be precisely the same as the fossil from Ganges Harbour, on Salt Spring or Admiralty Island, to which the name *Discina Vancouverensis* was given in the second part of this volume. This name, therefore, will have to be abandoned. In regard to the Comox River specimen, Dr. Woodward writes as follows : "The larger vertebra seems to belong to one of the Carchariidæ. We have some, generically undetermined, exhibiting the same kind of fracture."

Lamna appendiculata, Agassiz.

Otodus appendiculatus, L. Agassiz. 1843. Poiss. Foss., vol. III, p. 270, pl. xxxii, figs. 1—25.

Lamna appendiculata, A. S. Woodward. 1889. Cat. Foss. Fishes Brit. Mus., Part I, p. 393; which see for a full list of synonyms and references for this species.

A rather small, well preserved and practically perfect shark's tooth, from Brennan Creek, near Wellington, V. I., collected by the Rev. G. W. Taylor in 1901, and presented by him to the Museum of the Survey, appears to be referable to this species.

The tooth is strongly compressed, rather thin and a little broader than high. Its maximum height is 12.2 mm., and its greatest breadth 13.5. The crown is obliquely pointed and prominent, with a small denticle on each side. Its cutting edge is extremely thin and sharp, and its base very shallowly but angularly emarginate. At its mid-breadth and just above the base there is a faint shallow depression, partially filled by a very obscure and short longitudinal plication, with a still more obscure and shorter one on one side. The whole surface of the crown is smooth and polished. The root of the tooth consists of a flat strip of tissue without enamel, from 3.5 to 4 mm. high, running practically parallel to the root of the crown.

An imperfect but otherwise very similar tooth was collected by Mr. J. B. Tyrrell in 1885, from the Cretaceous rocks on the Battle River, Saskatchewan.

Although Agassiz once thought that this species is peculiar to the Chalk, Dr. Woodward now says that it ranges in time from the Gault to the Upper Chalk, and, in its geographical distribution, from the south of England and Northern Europe to New Jersey and North Queensland.

CRUSTACEA.

Decapoda.

Brachyura.

Plagiolophus Vancouverensis, Woodward.

Plagiolophus vancouverensis, H. Woodward. 1896. Quart. Journ. Geol. Soc. Lond., vol. LII, pp. 226–228.

The original description of this species is as follows, but the number prefixed to the name is omitted, and the numbers of the two figures are altered to suit this volume.

"Genus PLAGIOLOPHUS, Bell.

In this genus the carapace is transversely ovate, the regions of the cephalothorax are distinctly marked, front somewhat prominent, the eyes subdistant, superior border of the orbits with two fissures, etc."

Plagiolophus vancouverensis, sp. nov. (Figs 15 and 16 on this page; figs. 5 and 6 of the original description.)

"This crab is represented by four specimens, three of which I received from Mr. Whiteaves, and the remaining one is preserved in the Museum of the Geological Society.

"The carapaces vary in size from :—

		Millimetres. long	broad
1.	Geological Society's specimen	22	28
2.	From Comox River, Vancouver Island (fig. 15). .	20	25
3.	N. W. side, Hornby Island.....	16	20
4.	N. W. side, Hornby Island, (fig. 16).	10	13

"No. 1 and No. 2 are $\frac{1}{4}$ broader than long, No. 3 is $\frac{1}{5}$, and No. 4 is $\frac{1}{4}$ broader than long,

"The frontal border is straight; the rostrum is bifid, with two small rounded elevations divided by a groove; the orbital region is smooth and but little indented; the lateral borders are very gently rounded, the posterior border is nearly straight. The cardiac and metabranchial lobes, the metagastric and epibranchial lobes, and the two mesogastric lobes form three almost parallel lines across the carapace, giving it a very unique linear arrangement; there are also two much smaller lobes, one behind each of the orbits, flanked laterally by a small tubercle on each epibranchial lobe; the lateral border was bluntly dentated.

FIG. 15.

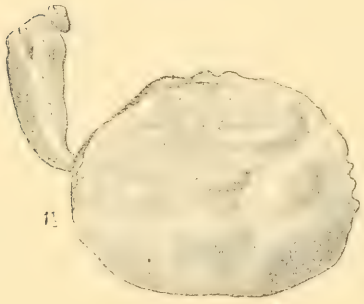
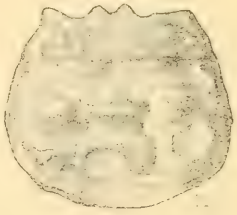


FIG. 16.



"When not waterworn (as in specimen No. 4), the surface of the carapace is in parts very finely granulated.

"These specimens are very distinct, but without more materials I should not feel justified in separating them generically. I prefer rather to place them in Bell's genus *Plagiolophus*, which was proposed to receive *P. Wetherelli*, from the London Clay of Sheppey.

"The same species—described under the name of *Glyphithyreus affinis* (Reuss)—was figured and described by Reuss nearly at the same date. Reuss also adds another species, *Glyphithyreus formosus*, Reuss, from the Upper Cretaceous of Mecklenburg.

"I feel satisfied to leave these Vancouver Island crabs in this genus, and to designate them by the trivial name of *vancouverensis*.

"Two specimens were collected on the north-western side of Hornby Island, and one on Comox River, Vancouver Island, British Columbia. The locality of the Geological Society's specimen is not marked, but it is from Vancouver Island.

"Nos. 3 and 4, from Hornby Island, belong to the Provincial Museum of Victoria, Vancouver Island.

"No. 2 specimen shows traces of limbs, and the flattened propodos of a chelate fore-arm 13 millim. long × 8 millim. broad."

The three specimens forwarded by the writer were collected by Mr. Walter Harvey, who says that he got one specimen of this species on the Puntledge or Comox River, at Comox, V.I., in 1891, several at Hornby Island in 1892, 1893 and 1896, and a few at Denman Island in 1892 and 1893. One of the specimens collected by Mr. Harvey at Hornby Island in 1896, and now in the Museum of the Survey, has almost the whole of the ten walking legs preserved.

Palæocorystes Harveyi, Woodward.

Palæocorystes Harveyi, H. Woodward. 1896. Quart. Journ. Geol. Soc. Lond., vol. LII, pp. 225 and 226.

The following is the original description of this species, but the number of the figure is altered to suit this publication.

"Genus Palæocorystes, Bell.

"In this genus the carapace is longer than broad, flattish, becoming narrower gradually towards the posterior border, rostrum short, latero-anterior border dentated. Orbits moderately broad, with two fissures.

"The carapace in all the species of this genus at present known is similar to that of the masked crab, *Corystes*, now living on our English coasts.

"*Palæocorystes Harveyi*, sp. nov. (Fig. 17.)

"The genus *Palæocorystes*, to which I have referred two of the specimens sent to me by Mr. Whiteaves, is well represented in the Gault Greensand, Chalk and Eocene.

"Thus we have :—

Palæocorystes Broderipii, Mantell, sp. ; Gault, Folkestone.
—— *Stokesii*, Mantell, sp. ; Gault and Greensand, Cambridge and Folkestone.
—— *Normanni*, Bell ; Chalk Marl, Isle of Wight.
—— *Mulleri*, Bink ; Upper Chalk, Maestricht.
—— *Callianassarum*, Fritsch ; Chalk, Bohemia.
—— *isericus*, Fritsch ; Chalk, Bohemia.
—— *glabra*, H. W. ; Lower Eocene, Portsmouth.
Eucorystes Carteri, M'Coy ; Greensand, Cambridge.

"Both the specimens from Canada are imperfect. One of them (No. 2, fig. 17) shows the anterior upper surface of the carapace, the other (No. 3) the posterior upper surface. From these we are able to make the following diagnosis :—

"*Specific characters.* Length of carapace 35 millim., from the rostrum to the broken posterior border (to this we must probably add 15 millim. more, making the total length from the rostrum to the posterior border of the carapace 50 millim.) ; greatest breadth across the hepatic region 37 millim.

Fig. 17.

"(No. 2 was collected by Mr. W. Harvey, Comox River, Vancouver Island, 1892 ; No. 3 by Dr. C. F. Newcombe.)

"Carapace smooth and gently convex in front, and very finely and minutely granulated. Latero-anterior border armed with four serrations on each side, frontal border marked by one prominent and one smaller tooth on either side of the small bifid rostrum, while two fissures mark the margin of each orbit. Under surface of carapace not exposed.

"The regions of the carapace are very indistinct ; two slightly divergent raised lines about 5 millim. in length mark the frontal region just behind the rostrum, and there is a faint ridge down the centre of the carapace. A small tubercle on either side, behind the frontal region, marks the epigastric lobe. A faint curved and bifurcating line separates the gastric from the cardiac regions, while two slightly rugose and incised lines curve outward and forward from the central cardiac region, marking the limits of the branchial region on either side.

"Of the several species of *Palæocorystes* known, the present form, which I have ventured to call *P. Harveyi* after its discoverer, approaches most nearly to *P. Broderipii* from the Gault of Folkestone, but is probably

one-third larger. The latero-anterior border of the former (*P. Harveyi*) has four spines on each side, whilst *P. Broderipii* has only two. The orbital regions differ in form, as well as the markings on the regions of the carapace.

"We must await more complete materials before attempting a fuller and more careful description; meantime it is interesting to meet with a species from so distant a locality which approaches so nearly to our own Gault species *P. Broderipii*.

"*Formation.*—Cretaceous. *Localities.*—Hornby Island (No. 2); and Comox River, Vancouver Island (No. 3)."

No. 2 is labelled "N. W. side of Hornby Island, W. Harvey, 1892"; and No. 3, "Comox River, at Comox, V. I., C.F. Newcombe, 1892"; but Mr. Harvey says that both were collected on the Puntledge or Comox River, and that the species has not yet been found at Hornby Island.

A third specimen of the carapace of *P. Harveyi*, collected on the Comox River by Mr. J. M. Bennett, in 1896, has been presented by him to the Museum of the Survey. It is very similar to the original of figure 17, but has more of the test preserved.

Macrura.

Callianassa Whiteavesii, Woodward.

Callianassa Whiteavesii, H. Woodward. 1896. Quart. Journ. Geol. Soc. Lond., vol. LII, p. 223, figs. 1 and 2; and (1900) Geol. Mag., Dec. IV, vol. VII, p. 435, pl. 17, figs. 2, *a b*.

Original description.—"General integument of body extremely thin, or semimembranous, except the first pair of feet, which are protected by a hard covering. Anterior feet (chelipeds) very unequal; length of larger limb 39 millim.; breadth 9 millim.; the dactylus is straight, and is 9 millim. long, but the fixed thumb of the propodos is rudimentary and stout, being only half as long as the movable finger. Length of smaller hand about 20 millim. Surface of hands faintly wrinkled.

"There are indications of the segments of the abdomen and of the thin integument with which they were covered, also of the small thoracic legs, but they are too much broken up for detailed description.

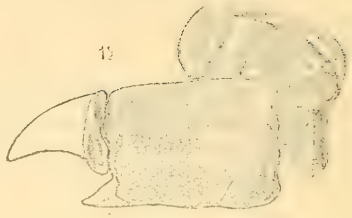
Fig. 18.

"In this species from Vancouver Island the fixed thumb of the propodos is shorter than in any of the

species hitherto recorded, and the movable finger (dactylus) is straighter.

"The species is smaller than that from the Chalk of Dulmen, Westphalia, or from Maestricht, or Belfast. I have designated it *Callianassa Whiteavesii*, in honour of my friend Mr. J. F. Whiteaves, who has done so much for the elucidation of the Cretaceous formation in Canada.

Fig. 19.



"Original specimens" (figs. 18 and 19) "preserved in concretionary nodules of Cretaceous age from Comox River, Vancouver Island. Collected by Dr. C. F. Newcombe (1892). Museum of the Geological Survey of Canada, Ottawa.

"A nodule from Vancouver Island, in the Geological Society's Museum, contains the remains of the large hands of *Callianassa Whiteavesii*. A second nodule from the same collection contains the carapace of *Plagiolophus vancouverensis*" (Woodward).

Remains of one or possibly two individuals, that Dr. Woodward has since identified with this species, had previously been collected on the Puntledge or Comox River, near Comox, by the Rev. G. W. Taylor in 1889, and are now in the Museum of the Survey. Specimens collected at Hornby and Denman islands by Mr. Harvey in 1892 or 1893, that are probably referable to this species, have been loaned to the writer by the authorities of the Provincial Museum at Victoria, B.C. Dr. Woodward also identifies with *C. Whiteavesii*, several "well-preserved, flattened chelate hands" collected at Sounding Creek (in the north-west corner of the District of Assiniboia), by Mr. J. B. Tyrrell, in 1886, but these are from the Pierre-Fox Hills or Montana formation, of the country east of the mountains.

Hoploparia Bennettii, Woodward.

Hoploparia Bennettii, H. Woodward. 1900. Geol. Mag., Dec. IV, vol. VII, p. 433.

Original description.—"This species is based on a very imperfectly preserved specimen, No. 5 in list, contained in a dark nodule (measuring 5″ × 2″) split in halves very irregularly, and exposing the dorsal aspect of five posterior abdominal somites and the telson with two swimmerets on the left side still attached. The abdominal segments are smooth, and the epimera broadly falcate and pointed as in *Homarus*. Length of five abdominal segments, 40 mm.; length of telson, 13 mm.; breadth of abdomen 25 mm.

"The sternites are still attached to the abdomen, but the carapace has been removed, exposing the inner and upper surface of the cephalothorax, with the bases of five pairs of ambulatory appendages still attached. Length of cephalothoracic portion, 30 mm. Some of the small ambulatory legs on the left side are preserved nearly to their extremities, and the bases of the large (chelate) fore-legs can also be seen, one joint of which shows a tuberculated surface. Length of base of area of sternites, 25 mm.; greatest breadth, 15 mm. There is no trace whatever of the presence of large palinurid antennæ. This and the general character of the thoracic appendages and the form of the abdomen, resembling the modern *Homarus* rather than *Palinurus*, lead me to refer this fossil to the genus *Hoploparia*. I have added the specific name of *Bennettii* after its discoverer.

"Formation: Upper Cretaceous.

"Locality: Comox River; collected by Mr. J. Bennett in 1895."—(Woodward).

No other specimen is known to the writer.

Enoploclytia minor, Woodward.

Enoploclytia minor, H. Woodward. 1900. Geol. Mag., Dec. IV, vol. VII, p. 434.

"The evidence for this species consists of a nodule (4″ × 3″, No. 9 in Dr. Whiteaves' list, marked also 59 in white paint) split into two parts, but affording little comfort to the investigator. One can make out an imperfectly preserved carapace (cephalothorax), with a tuberculated surface from which two pairs of imperfectly preserved antennæ take their origin and the flagella of which can be indistinctly traced. These are followed by a pair of long and slender chelate appendages, with finely tuberculated surfaces, the fingers of the forceps being long and slender as in *Enoploclytia Leachii*. Two pairs of slender ambulatory legs follow; these also have forcipated or chelate extremities. The abdominal segments are slender and only imperfectly preserved.

"The specimen is from the Upper Cretaceous of Hornby Island, and was obtained by Mr. W. Harvey in 1893." (Woodward.)

Eryma Dawsoni, Woodward.

Plate 41, fig. 2*.

Eryma Dawsoni, H. Woodward. 1900. Geol. Mag., Dec. IV, vol. VII, p. 400, pl. XVI, fig. 2.

"Among the specimens which form a second collection sent by Dr. J. F. Whiteaves (24th September, 1898) from the Geological Survey of

*Plates 40 and 41 of this volume are printed from the same stone as Plates XV and XVI of the Geological Magazine for September and October, 1900, but the lettering of the upper part of each of the former has been altered to suit this publication.

Canada, is the half of a nodule containing an Astacidean from the Upper Cretaceous of the north-east side of Hornby Island, British Columbia, collected by J. B. Bennett in 1898 (No. 55D).

"The Crustacean is seen in profile on the split surface of a nodule, and exhibits the cephalothorax, with its stout pair of chelate limbs (or forceps) attached, and the remains of the four pairs of succeeding ambulatory legs, the six abdominal somites, and the telson, but the lateral lobe of the tail-fin was probably preserved in the other half of the nodule not sent. The branchiostegite (covering the branchiæ) is broad and tumid, and the branchiocardiac groove is strongly marked. Starting from the median dorsal line as a \/-shaped furrow, about 12 millimetres from the posterior border, it bends rapidly forward, becoming deeper on each side, and reaches the lateral border 24 mm. in advance; here it unites, close to the hepatic lobe, with the equally deep but more transverse cervical furrow, which crosses the carapace 10 mm. nearer to the front. In advance of the cervical groove the postorbital ridge and spine can be seen, also the base of one of the antennules, with part of one of its flagella, beneath the somewhat short rostrum, and lower down the base of one of the outer and larger antennæ. The surface of the branchiostegite is marked by numerous small tubercles scattered irregularly over the surface. The branchial, cardiac, and hepatic regions are also similarly tuberculated, and very tumid. Length of carapace 48 mm., depth of side 25 mm. The ambulatory limbs are fairly long and slender; the chelate limbs measure about 60 mm. in length: length of penultimate joint 35 mm., breadth 15 mm., length of ultimate joint 20 mm. The fingers are long and slender, the inner edge of the forceps being denticulated; wrist 6 mm. long by 10 mm. broad. The epimeral border of each abdominal segment is falcate in contour.

"The general form and details of this Crustacean, so far as preserved, clearly mark its place among the Astacidea, or under the Astacomorpha (as defined by Huxley, 1881), and I would suggest that Oppel's name of *Eryma* is appropriate for it, seeing that it agrees very closely in the divisions of its carapace and its tuberculated surface, in the antennæ, the form of the first pair of forcipated chelæ, and the proportion of its abdomen, with *E. Perroni* and other Jurassic species.

"Oppel observes that no examples of the genus *Eryma* have been found in rocks younger than the Jurassic, and that the Astacidæ of the Chalk are placed in McCoy's genera *Hoploparia* and *Enoploclytia*, but in this instance the form in question agrees much more closely with Oppel's genus *Eryma* than with other forms. I therefore propose to relegate it to that genus, and to designate it by the specific name of *Dawsoni*, in honour of Dr. G. M. Dawson, C.M.G., F.R.S., the eminent Director of the Geological

Survey of Canada, who has done such splendid work in the field in mapping the geology of British Columbia."—(Woodward).

Meyeria ? Harveyi, Woodward.

Meyeria? Harveyi, H. Woodward. 1900. Geol. Mag., Dec. IV, vol. VII, p. 434.

"The evidence of this species rests on a single specimen exposed on the half of a fractured nodule ($3\frac{1}{2}$ inches × $2\frac{1}{2}$ inches), marked No. 8 in list. It is also marked 3 in ink. It was obtained by Mr. W. Harvey, in 1895, at Hornby Island, and shows the remains of the abdominal somites and the long slender rugose fore-limbs of the cephalothorax ($2\frac{1}{4}$ inches in length by $\frac{1}{8}$ inch in thickness). They do not appear to have possessed forceps at their extremities, but were monodactylous. The form of the epimera of the abdomen agrees with *Meyeria vectensis* in shape.

"From the Upper Cretaceous. Named after its discoverer, Mr. W. Harvey" (Woodward).

Glyphæa. Sp. nov.

Several specimens of a small and apparently undescribed species of *Glyphæa* were collected by Mr. Harvey in September, 1901, from shale forming the roof of the coal at No. 1 shaft, Nanaimo, V.I. Most of these specimens, however, are crushed, distorted or badly preserved, and none of them are sufficiently perfect to furnish the material for a detailed or sufficiently accurate description of the species. About all that can be said of its characters is that the rostrum is apparently short and pointed, and that the carapace, in front of the nuchal furrow, and the large pinching claws, are marked with narrow longitudinal ridges, and minute rounded tubercles that may be spine bases.

Linuparus Vancouverensis, Whiteaves.

Plate 40, figs. 1, 2 and 3.

Podocrates Vancouverensis, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. 1, p. 132.

Linuparus Vancouverensis, H. Woodward. 1900. Geol. Mag., Dec. IV, vol. VII, p. 394, plate XV, figs. 1, 2 and 3.

Original description.—"Carapace flattened, rectangular, longer than broad, marked by three low angular tuberculous or spinose longitudinal ridges, one in the median line and one near each of the lateral margins, and divided at about one-third of the distance from the front by an obtusely subangular cervical groove, which is rather broad but not very deep. On the anterior portion or cephalic arch the lateral longitudinal ridges are well

developed, and armed with larger and more spinose tubercles than those on the corresponding ridges of the posterior portion, one a little behind the mid-length on each ridge being larger than any of the others, but the central ridge is obsolete. In its place, just in advance of the cervical groove, there is an ovate lanceolate or narrowly spear-shaped area, which is elevated at the pointed end anteriorly, shallowly depressed posteriorly, and margined with a single row of small tubercles. Immediately in front of this area is a pointed or spinose tubercle, almost in a line with the largest tubercle on each of the lateral ridges, and still farther forward there are two similar tubercles at a short distance from the anterior margin and about seven millimetres apart. On the posterior portion or scapular arch, the three longitudinal ridges are minutely tuberculated, and extend from the posterior margin to the cervical groove, where they each terminate in a pointed tubercle larger than any of the rest, but the central ridge is shorter than either of the two lateral ridges. Anterolateral angles of the carapace, each armed with a nearly straight but slightly divergent spine. Rostrum, central portion of the anterior margin, and position of the eyes unknown. External antennæ broad and flattened at their bases, inner antennæ cylindrical at theirs. Walking feet slender, as is usual in the genus. In addition to the spines and tubercles on the lateral ridges and elsewhere, as already described, the whole of the upper surface of the carapace is minutely granulose and apparently setose, numbers of minute objects which seem to be detached setæ, being plainly visible under an ordinary lens.

"Two miles up the Puntledge River, Vancouver Island, Rev. G. W. Taylor, 1889: a good specimen of the carapace, with the rostrum and a small piece of the anterior extremity broken off, but with considerable portions of the ambulatory feet and the bases of the inner and outer antennæ preserved. This interesting fossil is now in the Museum of the Geological Survey of Canada. [See Pl. 40, Fig. 1.]

"Hornby Island, W. Harvey, 1893: a less perfectly preserved specimen, showing most of the carapace (but not the rostrum), portions of the ambulatory feet, and the dorsal aspect of four segments of the abdomen, though it is uncertain whether their margins were denticulated or not."

In regard to this Hornby Island specimen, Dr. Woodward says that it "shows the cephalothorax and a portion of the base of the left antenna. The three characteristic longitudinal ridges, the small central pear-shaped area in front of the neck-furrow on the carapace, and five of the abdominal segments can also be seen. Their margins are denticulated." (Geol. Mag., Sept., 1900, pp. 393 and 396.)

Three other specimens of this species have since been obtained, which are thus described by Dr. Woodward (op. cit., p. 393.)

"No. 4. A long, dark, and rather cylindrical nodule ($6\frac{1}{2}'' \times 2\frac{1}{2}''$), split in halves and also broken across transversely, exposing the interior of the cephalothorax and five segments of the abdomen of *Linuparus (P.) Vancouverensis*, W." (Pl. 40, Fig. 2). "The upper surface of the carapace is not preserved, but the bases of the mandibles (*m.*) are exposed, the monodactylous walking legs, and the bases of the antennules. The epimeral portions of the abdominal segments are serrated behind, and bear small tubercles on the surface. Formation: Upper Cretaceous. Locality: Comox River, Vancouver Island; coll. by J. B. Bennett, 1895.

"No. 6. Half of a nodule only ($7'' \times 4\frac{3}{4}''$), containing an obscurely preserved Crustacean, *Linuparus (P.) Vancouverensis*, showing characteristic traces of the carapace and limbs and the nearly entire abdomen, including remains of the caudal appendages. The posterior borders of the epimera are spinous. The right antenna is preserved for a length of $2\frac{1}{2}$ inches. Formation: Upper Cretaceous. Locality: Hornby Island; coll. by W. Harvey, 1895. (Specimen also marked No. 1 in ink.)

"No. 55 *a* and *b*. Two sides of a dark egg-shaped nodule split open ($4\frac{1}{2}'' \times 3\frac{3}{8}''$), exposing the dorsal aspect of a specimen of *Linuparus (P.) Vancouverensis*. W." (Pl. 40, Fig. 3), "showing the carapace and the five abdominal segments, also the remains of the caudal appendages and the thoracic limbs. The three characteristic ridges are well seen, also the cervical furrow, with its pear-shaped tuberculated area just in front. Formation: Upper Cretaceous. Locality: Hornby Island; coll. by Mr. Robbins in 1896, Provincial Museum, Victoria, British Columbia."

Linuparus Canadensis, Whiteaves.

Plate 41, fig. 1.

Hoploparia (?) Canadensis, Whiteaves. 1884. Trans. Royal Soc. Canada for 1884, vol. II, sect. IV, p. 237; and (1885) Contr. to Canad. Palæont., vol. I, p. 87, pl. XI.

Podocrates Canadensis, Whiteaves. 1896. Trans. Royal Soc. Canada, Second Series, vol. I, sect. IV, p. 133.

Linuparus atavus, Ortmann. 1897. Amer. Jour. Sc., Fourth Series, vol. IV, p. 290, and figs. 1, 2 and 3, facing page 296.

Linuparus Canadensis, Whiteaves. 1898. Contr. to Canad. Palæont., vol. I, p. 419; and H. Woodward (1900) Geol. Mag., Dec. IV, vol. VII, pp. 396-399, pl. XVI, fig. 1.

The type of this species is a single specimen from the Cretaceous shales of the Highwood River, Alberta, collected by Mr. R. G. McConnell in 1882. The Highwood is a tributary of the Bow River, and the shales at that locality are supposed to be the Canadian equivalents of the Fort Benton group of the Upper Missouri section.

Dr. Woodward (op. cit., pp. 398 & 399) identifies two specimens from Hornby Island with *L. Canadensis*, although no other species that the writer is aware of, is yet known to be common to the Nanaimo group of the Vancouver Cretaceous and the Fort Benton formation of the country to the east of the mountains. Dr. Woodward's notes on these Hornby Island specimens as are follows:

No. 55 *c*. One half of a dark nodule ($6\frac{1}{4}'' \times 4''$), exposing the under side of a large Crustacean, showing the five sternites and the bases of the thoracic limbs." (Pl. 41, fig. 1.) "I have referred this specimen to Dr. Whiteaves' species *L. Canadensis*, with which it agrees in size, being one of the largest specimens of the fossil Palinurids from this locality.

"It exhibits the under surface of the cephalothorax, with the sterna and the basal joints and portions of the five pairs of ambulatory appendages, one or more being nearly complete. The sternum forms a rather broad and somewhat triangular area, in front of which the mandibles and the labrum are seen, with the spinous stout basal joints of the long stiff antennæ. There are also traces of the antennules visible.

"Each sternite, carrying the thoracic limbs, is ornamented with a pair of rounded, sub-central tubercles, except the first, which has only a single central one.

"Upper Cretaceous: Hornby Island; collected by Mr. Robbins, preserved in the Provincial Museum at Victoria, B.C.

"Here I would also place a second specimen, preserved in a half nodule No. 7 (marked 2 in ink), which I refer to *L. Canadensis*. The half nodule measures $6'' \times 4''$, and displays one of the large antennæ and five of the walking legs very well preserved. The surface of the appendages is rugose. Three of the body-segments can be seen. Locality: Hornby Island; W. Harvey, 1895."

MOLLUSCA.

Cephalopoda.

(Dibranchiata.)

Belemnites. (Species indeterminable.)

Beach at Hornby Island, W. Harvey, 1892: a slender phragmocone, forty millimetres long and seven broad at the larger end. The chambers, as seen when part of the surface is rubbed down, are very numerous, and the siphuncle is marginal.

(Tetrabranchiata.)

Nautiloidea.

Nautilus Campbelli, Meek.

Nautilus Campbelli, Meek. 1861. Proc. Acad. Nat. Sc. Philad., vol. xiii, p. 318.
" " " 1876. Bull. Geol. and Geogr. Surv. Terr., vol. ii, no. 4, p. 373, pl. 6, figs. 2 & 2 *a*.
" " " Whiteaves. 1879. This volume, pt. 2, p. 99, pl. 11, figs. 2, 2 *a-b*.

North-west side of Hornby Island, W. Harvey, 1895 : one specimen. The type of *N. Campbelli* was collected at Comox, V.I., apparently by Mr. George Gibbs in 1858. Mr. Richardson obtained one specimen of this species at Hornby Island in 1872, and another at the Sucia Islands in 1875. It is most likely also that the specimen from the Nanaimo River referred to on page 100 of this volume, which, according to Dr. Shumard, "appears to be identical with *Nautilus DeKayi*, Morton," is referable to *N. Campbelli*.

Nautilus Suciensis, Whiteaves.

Nautilus Suciensis, Whiteaves. 1879. This volume, p. 97, pl. 11, figs. 1 & 1 *a* ; but not the specimens from the Queen Charlotte Islands described on pp. 197 and 198, one of which is figured on pl. 21.

Sucia Islands, Dr. C. F. Newcombe, 1894 : one imperfect specimen. This is the only locality at which the species, as now restricted, has been collected.

Ammonoidea.

Phylloceras ramosum, Meek.

Ammonites (Scaphites ?) ramosus, Meek. 1857. Trans. Albany Inst., vol. iv, p. 45.
Phylloceras ramosus, Meek. 1876. Bull. Geol. and Geogr. Surv. Terr., vol. ii, No. 4, p. 371, pl. 5, figs. 1, 1 *a* and 1 *b*.
Ammonites Velledæ, Whiteaves. 1879. This volume, pt. 2, p. 103 ; but apparently not of European authors, as now understood.

North-west side of Hornby Island : W. Harvey, 1892, two fine specimens ; F. W. Robbins, 1893, two specimens ; and W. Harvey, 1895, one specimen. East side of Denman Island, W. Harvey, 1895 : a crushed and imperfect but large specimen about four inches and a half in its maximum diameter. Brennan Creek, near Wellington, V. I., Rev. G. W. Taylor, 1901 : a small but well preserved specimen. The species had previously been collected at Nanaimo, Comox, and the Sucia Islands

Dr. C. F. Newcombe informs the writer that in the Provincial Museum at Victoria, V.I., there is a specimen collected at the north end of the western limb of the main Sucia Island by H. K. Kalloch in 1894, that is apparently referable to *P. ramosum*, and that is eighteen inches in its maximum diameter. Two excellent photographs of this specimen, kindly forwarded by Dr. Newcombe, certainly seem to corroborate the correctness of this identification. They give the impression of a shell with essentially the same surface markings and much the same general shape as the small specimen of *P. ramosum* figured by Meek (which is less than two inches in its maximum diameter), but with a proportionately rather wider umbilicus. In this large specimen the umbilicus seems to occupy nearly one-sixth of the entire diameter, and it clearly exposes a small portion of some of the inner volutions. The sutural lines are for the most part covered by the test, but in the few places where portions of them are exposed, they appear to be very like those of the typical *P. ramosum*.

One of the Ammonites sent to Dr. Kossmat in 1896, is the specimen of *P. ramosum* from Hornby Island collected by Mr. Harvey in 1895. Its test is well preserved and its maximum diameter is about two inches. Judging by this specimen, Dr. Kossmat thinks that both *P. ramosum* and *P. Nera* (the *Ammonites Nera* of Forbes) are distinct from the true *P. Velledæ* (the *Ammonites Velledæ* of European authors and of the Palæontologia Indica), but that *P. ramosum* is the same as *P. Nera*, and should therefore be called by the latter name. In the Hornby Island specimen of *P. ramosum*, Dr. Kossmat writes that he sees "short radiating impressions round the umbilicus," like those of *P. Nera*, but these appear to the writer to be merely very indistinct, shallow, distant, radiating depressions. It is quite possible that *P. ramosum* may be synonymous with *P. Nera*, but for the present the writer prefers to retain the former name for the specimens from the Vancouver Cretaceous.

Phylloceras Forbesianum, d'Orbigny. (Sp.)

Ammonites Rouyanus (d'Orbigny) Forbes. 1845. Trans. Geol. Soc. Lond., Ser. 2, vol. VII, pl. 8, fig. 6.

Ammonites Forbesianus, d'Orbigny. 1850. Prodr. de Paléont., vol. II, p. 213.

Ammonites Rouyanus, Stoliczka. 1865. Cret. Cephal. S. India, vol. I, p. 117, pl. 59, figs. 5—7.

Phylloceras Forbesianum, Kossmat. 1894. Beitr. zur. Palæont. Oesterreich-Ungarns, vol. IX, p. 109 (13); and pl. 15 (1), figs. 1, *a—d*.

A specimen from the north-west side of Hornby Island, collected by Mr. Harvey in 1895, and now in the Museum of the Survey, has been identified with this species by Dr. Kossmat. It is a cast of the interior

of the shell, about two inches and three-quarters in its maximum diameter. A little of the shell is preserved on the cast, and the sutural line is excellently well shown.

Gaudryceras Denmanense, Whiteaves.

Ammonites Jukesii? Sharpe. Whiteaves. 1879. This volume, pt. I, p. 111, pl. 13, figs. 3, 3 *a*, *b*; but perhaps not the true *A. Jukesii*, Sharpe.

Lytoceras Jukesii, Whiteaves. 1896. Trans. Royal Soc. Canada, Second Series, vol. I, sect. IV, p. 129, pl. 2, figs. 1 and 2.

Lytoceras (Gaudryceras) Denmanense, Whiteaves. 1901. Ottawa Naturalist, vol. XV, p. 32.

Seven fine examples of this beautiful species, three of which are now in the Museum of the Survey, were collected at Denman Island, near Hornby Island, in the Strait of Georgia, by Mr. Harvey, four in 1892 and three in 1895. A characteristic fragment, also, of *G. Denmanense*, was collected at Hornby Island by Mr. Harvey in 1892. A small specimen, some forty-three millimetres in its greatest diameter, collected at Brennan Creek, V. I., by the Rev. G. W. Taylor in 1901, is probably referable to this species. The only other specimen of this shell that the writer has seen is the fragment from Norris Rock referred to, under the name *Ammonites Jukesii*, on page 112, and figured on Plate 13, of the second part of this volume.

Tetragonites Timotheanus? Mayor.

Cfr. *Ammonites Timotheanus* (Mayor) Pictet and Roux. 1847. Moll. des Grès Verts, &c., p. 39, pl. II, fig. 6, and pl. III, figs. 1 and 2.

" " " Stoliczka. 1865. Cret. Cephal. S. India, vol. I, p. 146, pl. 73, figs. 3, 4 and 6.

" " " Fr. Schmidt. 1873. Petrif. der Kreide von Sachalin, p. 14, pl. II, figs 7–11.

" " " Whiteaves. 1876. This volume, pt. I, p. 41, pl. 3, figs. 2 and 2 *a*.

Cfr. *Lytoceras Timotheanum*, Whiteaves. 1884. Idem, pt. 3, p. 203 (which see for some synonyms that it is not thought desirable to reprint here).

Cfr. *Lytoceras (Tetragonites) Timotheanum*. Kossmat. 1894. Beitr. zur Palæont. Oesterreich-Ungarns und des Orients, vol. IX, p. 133 (37), pl. XVII (III), figs. 11 and 13 *a*, *b*.

Four specimens, that agree very well with Stoliczka's description and figures of *Ammonites Timotheanus*, have recently been found in the Vancouver Cretaceous. The specimens, which are now in the Museum of the Survey, are, at any rate, essentially similar to those from the Queen Charlotte Island Cretaceous that are referred to *A. Timotheanus* in the

first part of this volume, and to *Lytoceras Timotheanum* in the third and fourth. Figure 2 of Plate III of the first part of this volume, which was intended to represent a small specimen of *A. Timotheanus* from Skidegate Inlet, is however not very satisfactory, the periodic constrictions being much too flexuous in the lateral region. In fact, the only difference that the writer has been able to detect between the specimens from British Columbia and Stoliczka's figures of *A. Timotheanus* is that, in the former, these constrictions are nearly straight, as well as very oblique, on the sides ; and in the latter they are slightly curved. And, it should also be borne in mind, that, according to Dr. Kossmat, the geological horizons of *Tetragonites Timotheanus* are the Upper Gault and Lower Cenomanian, so that everywhere else than in Vancouver Island, the species would appear to occur in deposits that are much older than the Nanaimo group or Senonian.

These four specimens from Vancouver Island may be briefly indicated as follows :

One is a cast of the interior of the shell, with a small portion of the test preserved, collected on the Puntledge or Comox River, near Comox, by Mr. Harvey in 1895. Its maximum diameter is fifty-eight millimetres, it shows two oblique constrictions anteriorly, but at some distance from the aperture, and portions of the sutural line are preserved in places.

Two are specimens, with the test preserved on one side, collected some ten or twelve miles up the Nanaimo River by Mr. Harvey in 1901. One of these is seventy-four millimetres, or nearly three inches in its greatest diameter, the other seventy-one mm. The larger one shows a portion of a constriction, at the aperture, the smaller one no indication of any constriction, yet the latter, in shape and size, is extremely similar to a specimen from Cumshewa Inlet, in the Queen Charlotte Islands, collected by Dr. G. M. Dawson in 1878, which shows six periodic constrictions. Both show many minute oblique striæ on the side, parallel with the direction that the constrictions always take in British Columbia specimens.

The fourth is a specimen sixty-eight mm. in its maximum diameter, and showing one periodic constriction, near the aperture, collected by the Rev. G. W. Taylor, at Brennan Creek, in 1901.

In each of these Vancouver Island specimens, the outer volution is distinctly subquadrate, the sides and the siphonal and antisiphonal region being flattened.

Stoliczka (op. cit) says that it is only the young shell of *Ammonites Timotheanus* that is marked with from six to seven constrictions (junioribus 6-7 sulcatis).

In Eastman's translation of Zittel's Text-book of Palæontology, Hyatt regards *Tetragonites* not only as a distinct genus, but as the type of a new family which he calls the Tetragonitidæ.

Pseudophyllites Indra, Forbes. (Sp.)

Ammonites Indra, Forbes. 1845. Trans. Geol. Soc. Lond., Ser. II, vol. VII, p. 105, pl. VI, fig. 7.
" " Stolizka. 1865. Cret. Cephal. S. India, vol. I, p. 112, pl. LVIII, fig. 2.
" " Whiteaves, 1879. This volume, pt. 2, p. 107, pl. 13, fig. 2.

Lytoceras (*Pseudophyllites*) *Indra*, Kossmat. 1894. Beitr. zur. Palæont. Oesterreich-Ungarns und des Orients, vol. IX, p. 137 (41), pl. XVI (II), figs. 6 *a*, *b*, 7, 8, *a*, *b*, 9, *a*, *b*; pl. XVII (III), figs, 6, and 7, *a*, *b*; and pl. XVIII (IV), fig. 3.

A few additional specimens of this species were collected at Hornby Island, by Mr. Harvey, between the years 1890 and 1896, and determined by the writer. Most of these are now in the Provincial Museum at Victoria. Dr. Kossmat, also, says that he saw a specimen of *P. Indra*, collected at Vancouver Island, by Sir James Hector, in the Natural History Department of the British Museum at South Kensington.*

Heteroceras elongatum. (N. Sp.)

Plate 44, fig. 2.

Heteroceras Conradi, Whiteaves. 1879. This volume, pt. 2, p. 100, pl. 12; but probably not *Ammonceratites Conradi*, Morton (1839).

Shell composed of a calcareous tube, which is at first coiled in a regular elongated spiral, as in *Turrilites*, but which is ultimately free and partially uncoiled. Spiral portion either dextral or sinistral, narrowly elongated, longer than wide; volutions rounded, ventricose and inflated externally, rather obliquely coiled, in contact at the suture, but with a narrow umbilical cavity or perforation between them. Uncoiled portion and sculpture of both portions, as previously described on page 101 of the second part of this volume.

The specimens collected by Mr. Richardson, which were referred to *Heteroceras Conradi*, are very imperfect and do not shew the shape and proportions of the spire, or closely coiled portion of the shell, at all well. This feature is much better seen in two sinistral specimens from Hornby Island, collected by Mr. Harvey, in 1895, and especially in the one figured on Plate 44. The discovery of these two fossils has led to the conclusion

* Jahrbuch der K. K. Geologischen Reichsanstalt, Wien, 1894, bd. XLIV, heft III, p. 472.

that they and the specimens collected by Mr. Richardson, are probably distinct from Morton's *Ammonceratites Conradi*, and it now seems desirable to distinguish the former by a different and new specific name.

The general contour and mode of coiling of *H. elongatum* seem to be essentially similar to those of *Heteroceras polyplocum*, Schluter, which is the type of Hyatt's recently proposed genus *Bostrychoceras*.

Mr. Harvey writes that he has collected many specimens of this species on the Puntledge, or Comox River, near Comox, V. I., a previously unrecorded locality for it.

Heteroceras Hornbyense, Whiteaves.

Plate 42, figs. 1, 2, 3 and 4.

Heteroceras Hornbyense, Whiteaves. 1895. Canad. Rec. of Sc., vol. VI, p. 316.
Heteroceras perversum, Whiteaves. 1895. Idem, p. 317. Sinistral variety.

Original descriptions:

H. Hornbyense. "Shell dextral, depressed turbinate, much broader than high, and composed, so far as is known, of five or six rounded, ventricose volutions, which are in close contact but without embracing; spire moderately elevated; umbilicus broad and deep, exposing the whole of the inner volutions.

"Surface marked with simple and not very flexuous transverse ribs. Upon the last volution one or two continuous ribs without tubercles alternate with a rib or pair of ribs which bears, or bear, a small but rather prominent tubercle on each side of the periphery. Usually two ribs coalesce, both above and below, at each tubercle, but occasionally a single thickened rib bears a pair of tubercles. In places, also, where the test is preserved, the surface is seen to be marked with fine raised lines, parallel to the ribs. Sutural line unknown.

"Maximum breadth of the outer volution of the largest specimen collected, nearly two inches and three-quarters.

"Hornby Island, W. Harvey, 1894; two specimens, one with most of three volutions, and the other with the whole of four volutions and a part of the fifth preserved."

H. perversum. "Shell sinistral, but in other respects essentially similar to that of the preceding species.

"Hornby Island, W. Harvey, 1894; a single specimen about an inch and three-quarters in its maximum diameter, with nearly the whole of one volution remarkably well preserved.

"It is not at all unlikely that the early volutions of *H. Hornbyense* may be coiled indifferently to the right or left, and if so, that this may be a mere sinistral variety of that species."

In one of the types of *H. Hornbyense*, it may be added, the summits of many of the ribs are curiously flattened downward, and this has since been found to be quite a characteristic feature of the species.

The foregoing descriptions refer exclusively to the spirally coiled portion of the shell, the only part that was then known. Since they were written, the writer has seen a few additional specimens of the species from Hornby Island, the only locality at which it is, so far, known to occur. Two of these, which are now in the Museum of the Survey, are of special interest. One is a sinistrally coiled specimen, with a considerable portion of two and a half of the earlier volutions preserved, collected by Mr. Harvey in 1895. This specimen, the original of figure 3 on Plate 42, has convinced the writer that *H. perversum* is only a sinistral variety of *H. Hornbyense*. The other, which is represented by figure 4 on the same Plate, is by far the largest specimen that the writer has seen, and was collected by Dr. Beadnell in 1895. It is also in the Museum of the Survey, and is septate throughout. It shews that *H. Hornbyense* (like *H. elongatum*) is at first spirally coiled, but that the calcareous tube of which it is composed becomes free, deflected, and bent abruptly on itself somewhat like the anterior and terminal end of a *Hamites* or *Ancyloceras*, before the commencement of the body chamber. Unfortunately in this specimen (as in that of *H. elongatum* figured on plate 12, figs. 1 and 1*a* of the second part of this volume) the deflected part of the shell is completely broken away and entirely disconnected from the spiral portion, so that, in each case, it is difficult to get a clear idea of the exact shape of the shell before it was broken. The tubercles on each side of the periphery or venter, in this large specimen, are narrowly elongated, in a direction parallel to the ribs of which they form a part. A transverse section of the deflected portion is nearly circular in outline, and the lateral diameter of the aperture is a little over an inch and a half. Here and there small portions of the septation are exposed, but in no place can a continuous sutural line be traced.

It may be that the spiral portion of the shell is more narrowly elongated than was at first supposed, and that this species also may prove to be referable to Hyatts' genus *Bostrychoceras*.

Hamites obstrictus, Jimbo.

Plate 44, fig. 3.

Hamites cylindraceus? Defrance. Whiteaves. 1879. This volume, pt. 2, p. 113, pl. XIV, figs. 2 and 2 *a*; but not *H. cylindraceus* of Defrance or d'Orbigny.

Hamites obstrictus, Jimbo. 1894. Beitr. zur Kennt. der Fauna der Kreideform. von Hokkaido, in Dames and Kayser's Palæontol. Abhandl., N. Ser., vol. VI, p. 38, pl. 7 (23), figs. 2 and 2 *a-b*.

Hamites obstrictus, Whiteaves. 1896. Trans. Royal Society of Canada for 1895, Second Series, vol. I, sect. 4, p. 130.

"Posterior extremity of the shell unknown, the prolonged and reflected portions slender, straight, almost circular in outline in transverse section, unless when abnormally compressed, and separated from each other by a space about equal in width to the maximum diameter of the reflected portion, near the aperture.

"Surface marked by prominent, narrow, simple and rarely bifurcating transverse ribs, which are rounded at their summits and separated by rather deep concave furrows. Besides the ribs, or rather furrows, there is a single transverse constriction on the reflected portion of the shell. On the prolonged portion the ribs are about one millimetre apart, but on the reflected portion they are nearly two millimetres apart.

"Sutural line as represented on Plate 14, fig. 2 *a*, of the second part of" this volume.

"Sucia Islands, J. Richardson, 1874: one crushed specimen, with the sutural line well preserved. North-west side of Hornby Island W. Harvey, 1893: two good specimens, one of them apparently free from distortion. All three, upon the whole, agree remarkably well with Jimbo's description and figures of *H. obstrictus*, although in that species there are two transverse constrictions of the prolonged portion of the shell, as well as one on the reflected portion, and the lobes and saddles of its sutural line are perhaps not quite so numerously incised as those of the specimen from the Sucia Islands." (Whiteaves, 1896, op. cit. supra, pp. 130 and 131.)

Quite recently the Imperial University of Tokio, per Mr. H. Yabe, has presented to the Museum of the Survey an authentic Japanese specimen of *H. obstrictus*. This specimen, though only a cast of the interior of the shell, with no portions of any of the sutural lines preserved, seems to be essentially similar to and practically indistinguishable from, the specimen collected at the Sucia Islands by Mr. Richardson.

Diplomoceras notabile. (N. Sp.)

Plate 44, figs. 4, 4 *a* and 4 *b*.

Shell very large when perfect, subcylindrical and transversely ribbed, ribs simple, leaving no impress upon the cast. The only specimen known to the writer is a nearly straight piece of the prolonged portion, from Hornby Island, about ten inches and three-quarters long, and septate for by far the greater portion of its length. It is slightly compressed at the sides, broadly oval and not far from circular in transverse section. Near the smaller end it measures forty-seven millimetres in its diameter from the siphonal to the antisiphonal side, and thirty-eight mm. in its lateral diameter. Near the larger end the corresponding measurements are fifty-five mm. by forty-six.

The ribs are numerous, closely and regularly disposed, nearly transverse, but slightly oblique, rounded, and about as wide as the shallowly concave grooves between them. On the middle of each side there are about eight and a half ribs to the inch near the smaller end, and seven at the larger. In addition to the ribs there are two widely distant, narrow, transverse constrictions, running parallel with them.

The sutural lines, although well preserved, and exposed over a considerable portion of the surface of one side of the specimen, are so complicated and crowded that it is almost impossible to follow any one of them quite continuously from the siphonal to the antisiphonal side. A careful study, however, show that the septation of this specimen is essentially similar to that of *Hamites cylindraceus*, as figured by d'Orbigny on Plate 136, figure 4, of the Atlas to the first volume of the "Terrains Cretacés," which is the type of Hyatts recently proposed genus *Diplomoceras*. In both there are six lobes, viz., two large laterals (the "latéral supérieur" and the "latéral inférieur" of d'Orbigny) on each side; one siphonal lobe and one antisiphonal. In both, also, the two lateral lobes, on each side, are very nearly equal in size. But the lobes and saddles of the Hornby Island specimen are still more numerously incised than are those of the French fossil, and this may be easily seen by comparing the siphonal saddle, the largest of the three accessory saddles between the first and second laterals, and the antisiphonal lobe, of both. The figure of the siphonal saddle of *H. cylindraceus* in the Atlas to the Terrains Crétacés, for example, represents it as entire at the summit and only twice incised on each side, whereas in the Hornby Island specimen, the same saddle is twice incised at the summit and four times on each side.

North-west side of Hornby Island, the specimen described and figured, which has most of the test preserved on one side, but very little on the

other. It was collected by Captain Gardner who kindly lent it to the writer for examination and description in 1898, and since then it has been returned.

This remarkable fossil is evidently much more closely allied to the *Hamites cylindraceus* of European authors than is the small and slender specimen from the Sucia Islands that the writer once doubtfully referred to that species. The former seems to differ from *H. cylindraceus* only in its much more distinctly defined, though rather narrow, annular costæ, and in the more numerous incisions in the lobes and saddles of its sutural line. It may prove to be nothing more than a local or geographical variety of *H. cylindraceus*. D'Orbigny describes the ribs of that species by the phrase "costis simplicibus evanescentibus," and gives the length of a specimen as 320 mm., or not quite thirteen inches. Pictet, on page 99 of the second volume of the Paléontologie Suisse, says that the ribs of *H. cylindraceus* are "très effacés."

Anisoceras Cooperi, Gabb. (Sp.)

Plate 43, fig. 1.

? Ammonites Cooperi, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I., p. 69, pl. 14, figs. 23 and 23 *a*.

? Hamites Vancouverensis, Gabb. 1864. Idem, vol. I, p. 70, pl. 13, fig. 18.

? Hamites (? Ancyloceras) Vancouverensis, Gabb. 1869. Idem, vol. II, p. 212.

Heteroceras Cooperi (Gabb) Meek. 1876. Bull. Geol. and Geogr. Surv. Territ., vol. II, p. 367, pl. 3, figs. 7 and 7 *a*.

Anisoceras Vancouverensis, Whiteaves. 1895. Canad. Rec. Sc., vol. VI, p. 313, pl. II; and (1896) Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 131.

The name "*? Ammonites Cooperi*" was proposed by Gabb for two or three very much compressed fragments from near San Diego, the best of which is figured on Plate 14 of the first volume of the Palæontology of California. This fragment does not give the least idea of the shape of the shell, when entire, and its sculpture is thus described. "The surface is ornamented by two rows of nodes (on the side?) with ribs extending across, some passing through one, some through two of the nodes; while others originate in one and end in another. By the peculiar arrangement of the ribs, there are about a third more on the middle of the fragment than on the margins." A portion of the sutural line of this specimen is also described and figured.

In the same volume, Mr. Gabb describes and figures a specimen from Comox, which seems to have a very similar kind of sculpture, under the name *Hamites Vancouverensis*. The figure of this specimen shews one straight limb abruptly bent on itself, as in *Hamites*, but, in the second

volume of the Palæontology of California, Mr. Gabb refers it doubtfully to *Ancyloceras*. Its surface is said to be "marked by numerous sharp ribs crossing the shell, inclined obliquely forwards; well marked, but diminished in size on the ventral side; largest laterally; each rib carrying a small flattened tubercle on the latero-dorsal angle; some ribs in the curve, on the ventral side, exhibit a tendency to tuberculation, but the shell being broken off at that point, their presence cannot be certainly determined. Interspaces between the ribs broadly concave." Its septum is said to be unknown.

Mr. Meek, in 1876, referred a large fragment from Comox, "with much doubt, to the species described by Mr. Gabb under the name *Ammonites ? Cooperi*" and describes and figures it under the name *Heteroceras Cooperi*. This fragment does not give any idea of what the shape of the entire shell was like. Its surface is said to be "ornamented by moderately distinct annular costæ, which pass around rather obliquely. Two rows of nodes also occur on the outer or dorsal side, at which points the costæ usually bifurcate."

In 1893 and 1895 a few much more perfect specimens, which the writer has identified with *Hamites Vancouverensis*, were collected at Hornby Island, and two of these were described at some length, under the name *Anisoceras Vancouverense*, in the "Canadian Record of Science," for April, 1895. In this publication the largest and most perfect of these specimens, which has since been presented to the Museum of the Survey by Mr. Harvey, is figured in outline. This specimen, it is stated, "has convinced the writer that *Hamites Vancouverensis* is a true *Anisoceras*, allied to *A. armatum*, Sowerby, but devoid of lateral tubercles, also that the fragment from Comox described and figured by Meek as *Heteroceras Cooperi*, is probably a small piece of the abruptly bent part of *Anisoceras Vancouverense*. "A similar fragment," now in the Survey collection, "was collected quite recently by Mr. Harvey at Hornby Island. "It is most likely also that the fragments of the shell of a cephalopod from the Chico group of California, for which Gabb proposed the name *Ammonites Cooperi*, are distorted pieces of *A. Vancouverense*, and if that be the case the laws of priority may require that the species shall be called *Anisoceras Cooperi*, Gabb, (sp.), as the description of Gabb's *Ammonites Cooperi* immediately precedes that of his *Hamites Vancouverensis*." On the "similar fragment" from Hornby Island, referred to in the foregoing quotation, the tubercles or nodes on each side of the venter are so prominent, conical and pointed as to suggest the idea that they are spine bases.

Since the paper in the "Record" was written, the writer has seen three additional specimens of this species from Hornby Island, two of which have been presented to the Survey Museum. One of these is the beauti-

ful fossil figured on Plate 43, which was collected by Mr. F. W. Robbins in 1893. Another is a well preserved example of an unusually small variety of the species, collected by Dr. Beadnell, and presented to the Harrogate Museum in England. Through the liberality of the authorities and members of that institution, however, and with Dr. Beadnell's consent, this interesting and in its way unique specimen has been permanently transferred to the Survey collection. It is imperfect at both ends, and measures not quite three inches and a half in its greatest length, by about two inches in its maximum breadth. At the end the farthest removed from the bend, the distance between the two limbs is not more than five millimetres. On the prolonged limb the ribs are unusually fine and numerous, but on the anterior portion of the reflected limb, and especially near the aperture, they rapidly become more distant and less numerous. At the smaller end of the prolonged limb a small portion of the septation is exposed, but no considerable portion of a continuous sutural line can anywhere be traced. No other specimen that the writer has seen, shews any vestige of the septation.

Anisoceras subcompressum, Forbes. (Sp.)

Plate 45, figs. 1, 1 *a*, and 1 *b*.

Hamites subcompressum, E. Forbes. 1845. Trans. Geol. Soc. Lond., Second Series, vol. VII, p. 116, pl. XI, fig. 6.

Anisoceras Indicum, Stoliczka (1865) non Forbes. Cret. Cephal. S. India, vol. I, p. 181, pl. LXXXV, figs. 1–5.

Hamites (Anisoceras) subcompressum (Forbes) Kossmat. 1894. Beitr. zur. Palæont. Oesterreich-Ungarns und des Orients, bd. IX, p. 145 (49), pl. XIX (V), figs. 10, *a-b*, 11 *a-b*, and 12.

Trent River, V.I., below the Falls, J. Richardson, 1872 : one specimen. Puntledge or Comox River, near Comox, V.I., W. Devereux, 1890, the specimen figured ; and S. J. Cliffe, 1893 (?), one specimen ; the property of the Provincial Museum at Victoria, V.I.

The most perfect of these, the specimen figured, is at first coiled in an irregular, loose, open spiral, but it rapidly straightens out afterwards towards the aperture. It consists of rather more than one volution, which is not coiled upon quite the same plane, its earliest portion being curved a little to one side. In the specimen from the Trent River, however, the straighter anterior portion is a little twisted laterally. The surface of all the specimens is marked by thin, sharp and simple transverse ribs, with concave grooves between them. In most of the specimens the ribs are somewhat distant over the whole of the surface, but in the specimen figured they are comparatively close together posteriorly. Septum unknown.

These specimens can scarcely be satisfactorily distinguished from the *Anisoceras* which Stoliczka describes and figures under the name *A. Indicum* in the "Palæontologia Indica," but which Kossmat says is the *Hamites subcompressus* of E. Forbes. Dr. Kossmat, who has kindly compared two of those from Comox with Indian specimens, has come to the same conclusion. "The specimens from Vancouver," he writes, "agree, when adult, in all features with Forbes' *H. subcompressus*, but in young stages their section is almost circular, whilst the true *H. subcompressus* has in all stages a compressed, oval section. "The Vancouver specimens, therefore, are, to a certain extent, intermediate between *H. Indicus* and *H. subcompressus*, but are more connected with the latter. They seem, also, to have some constrictions, which are a common feature of *H. subcompressus*."

Baculites Chicoensis, Trask.

Baculites Chicoensis Trask. 1856. Proc. San Francisco Acad. Nat. Sc., p. 85, pl. 2, fig. 2.
Baculites ovatus (Say?) Meek. 1857. Trans. Albany Inst., vol. IV, p. 48.
Baculites inornatus, Meek. 1861. Proc. Acad. Nat. Sc. Philad., vol. XIII, p. 16.
Baculites occidentalis, Meek. 1861. Idem. p. 16.
Baculites Chicoensis, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 80, pl. 14, figs. 27, 29 and 29 *a*; and pl. 17, figs. 27 and 27 *a*.
" " Meek. 1876. Bull. Geol. and Geogr. Surv. Terr., vol. II, p. 364, pl. 4, figs. 2 and 2 *a*, *b*, *c*.
Baculites occidentalis, Meek. 1876. Idem. p. 366, pl. 4, figs. 1, 1 *a*, *b*.
Baculites Chicoensis, Whiteaves. 1879. This volume, pt. 2, p. 114.
Baculites occidentalis, Whiteaves. 1879. Idem, p. 115.
Baculites Chicoensis, C. A. White. 1889. Bull. U.S. Geol. Surv., No. 51, p. 47.

Since the second part of this volume was written, the writer has seen a few additional specimens of *Baculites* collected at Comox by Lady Douglas in 1889, at Hornby Island by Mr. Harvey in 1894, and at the Sucia Islands by Dr. Newcombe in 1894. These are here referred to *B. Chicoensis*, in accordance with the opinion expressed by Dr. C. A. White in 1889 (op. cit. supra), in which the writer fully concurs, that he has "much doubt whether there is more than one species of *Baculites* in the Vancouver group."

Hoplites Vancouverensis, Meek. (Sp.)

Ammonites Vancouverensis, Meek. 1861. Proc. Acad. Nat. Sc. Philad., vol. XIII, p. 317.
Placenticeras Vancouverense, Meek. 1876. Bull. Geolog. and Geogr. Surv. Terr., vol. II, p. 370, pl. 6, figs. 1, 1 *a-c*.
Ammonites Vancouverensis, Whiteaves. 1879. This volume, pt. 2, p. 103.
Hoplites Vancouverensis, Whiteaves. 1893. Trans. Royal Soc. Canada for 1892, vol. X, sect. IV, p. 118.

A few specimens of this shell were collected at the Sucia Islands by Dr. C. F. Newcombe in 1894 and 1896.

Genus Pachydiscus, Zittel (1884).

A. Normal forms, in which the cast of the interior of the shell is uniformly devoid of transverse and periodic constrictions.

Pachydiscus Otacodensis, Stoliczka. (Sp.)

Plate 46, fig. 1.

Ammonites Otacodensis (pars) Stoliczka. 1865. Cret. Cephal. S. India, vol. I, p. 109, pl. LIV, figs. 3 and 4, and pl. LVI (but not pl. LVII); fide Kossmat.

Pachydiscus Otacodensis, Kossmat. 1894. Jahr. K. K. Geol. Reichsanstalt Wien, vol. 44, p. 472.

Pachydiscus Otacodensis, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 131.

Pachydiscus Otacodensis, Kossmat. 1897. Beitr. zur Palæont. Oesterreich-Ungarns und des Orients, p. 98 (163, pl. XVI (XXII), figs. 1 *a* and 1 *b*; and pl. XVII (XXIII) fig. 1.

Two specimens from the Vancouver Cretaceous have been identified with this Indian species by Dr. Kossmat. One of these, which the writer has not seen, is said to be a fine specimen collected at Nanaimo, V. I., by Sir James Hector (presumably in 1860) and now in the Natura History Department of the British Museum. The other, No. 14 of the small series of Ammonites sent to Dr. Kossmat, and the original of figure 1 on Plate 46, is a well preserved specimen collected at Hornby Island, by Mr. F. W. Robbins, in 1895, and presented by him to the Museum of the Survey. It measures about five inches and a half in its greatest diameter, and its aperture is higher than wide, elliptic subovate, but deeply emarginate by the encroachment of the preceding volution.

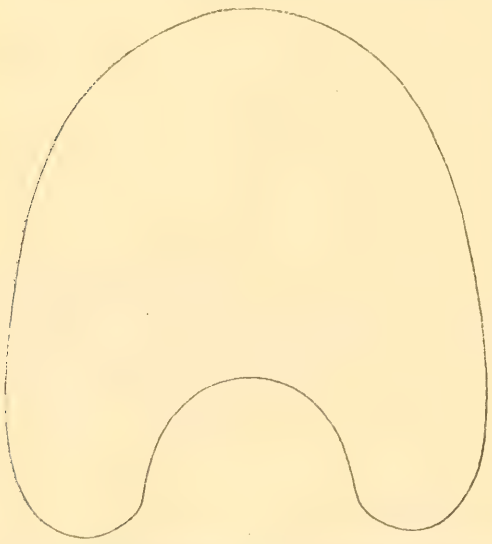


Fig. 20.—*Pachydiscus Otacodensis.* Outline of transverse section of the outer volution, near the aperture, of the specimen from Hornby Island represented on Plate 46.

Its umbilicus, which is rather deep and step-shaped, has a rounded margin, and occupies about one-fourth of the whole diameter. On the outer volution the surface markings consist of distant, narrow, low and rather flexuous, transverse ribs, which become fainter with age and are almost obsolete near the aperture. On the periphery or siphonal region, at a short distance from the aperture, six of the ribs are from nine and a quarter to twelve and a quarter millimetres apart. The spaces between these ribs are comparatively broad and nearly flat, and where the test is preserved, the interspaces are marked with a few obscure minute transverse riblets, or small, faint, rounded and very slightly raised ridges, that are parallel to the ribs.

In the Museum of the Survey there are four other specimens, which, in the writer's judgment, possess essentially similar characters, and therefore are probably also referable to *P. Otacodensis*. Three of these are from the Comox River, near Comox, V.I., collected by Mr. Harvey in 1893; and one from Hornby Island, collected by Mr. Harvey in 1895.

The figured specimen presented by Mr. Robbins, has been examined by Dr. Kossmat, who has forwarded the following notes in regard to it. "No. 14 agrees in all essential characters with the types of *P. Otacodensis* found near Otacod in the collection of Mr. Worth. Sometimes the umbilical wall of the Indian specimens is somewhat higher than in No. 14, but this character is variable, and I have before me, also, shells which agree in this feature with your specimen. The ribs of No. 14 fade off near to the umbilical wall, whilst in most of the Indian specimens they reach down only to the middle parts of the sides; but I have seen in the Hector collection, a Canadian specimen, (mentioned in my paper in the Jahrbuch K. K. Geol. Reichsanstalt) showing the same style of sculpture as the Indian specimens, and there are, on the other hand, individuals of otherwise typical *P. Otacodensis*, with relatively long ribse which also disappear near the umbilical wall, so that there is no specific difference between the specimen from Vancouver and *P. Otacodensis*.

"The only difference, which seems to be constant, is the following: on *P. Otacodensis* the ribs of the external region are relatively closely arranged in young and old stages, whilst in a middle stage, (when about 6 or 7 cm. in diameter) the distance of the ribs apart is about 1 to 1½ cm. (sometimes even more) while in the Canadian specimen the distance is never so great. But I cannot think that this can be considered as of specific value, though perhaps it might be desirable to regard the Vancouver form as a local variety. The septa agree perfectly in the arrangement of saddles and lobes, and in every detail. Plate LVI in Stoliczka's work represents a specimen with relatively coarse ribs, but, as

a rule, the ribs on the outer volution are not more developed than on the Canadian specimen No. 14."

Pachydiscus Neevesii. (N. Sp.)

Plate 47, fig. 1.

Shell compressed convex and rather narrowly umbilicated, volutions somewhat closely convolute, a little more than half of the inner ones being

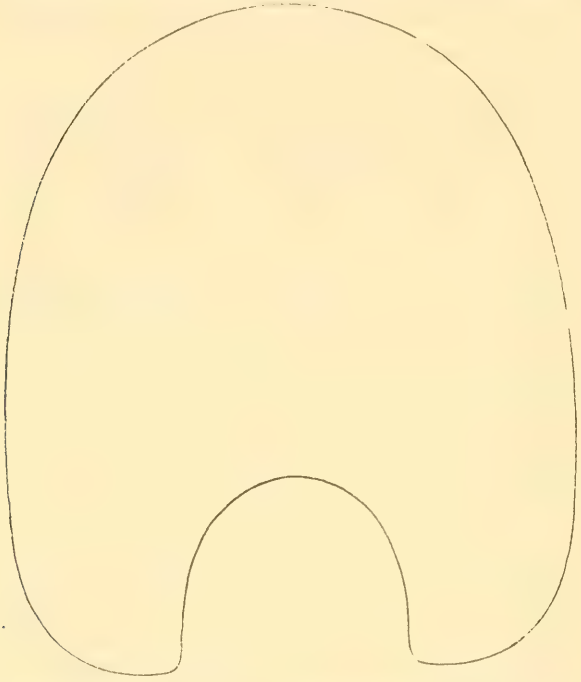


Fig. 21.—*Pachydiscus Neevesii.* Outline of transverse section of the outer volution, near the aperture, of the specimen from James Island represented on Plate 47.

covered by those that succeed them; umbilicus occupying one-fourth of the entire diameter, its margin rounded and its inner wall rather steep. Aperture higher than wide, broadly subelliptical, but rather deeply emarginate by the encroachment of the preceding volution.

Surface of the outer volution marked with numerous, very slightly elevated, gently flexuous, transverse ribs, which are everywhere much narrower than the very shallowly concave or nearly flat spaces between them. On the periphery and near the aperture of the specimen figured the ribs average from two to three millimetres in breadth, and from

seven to ten (but exceptionally sixteen) mm. apart at their summits. Most of these ribs are simple and continuous, from the umbilical margin on one side to that on the other, but they occasionally almost bifurcate or trifurcate at or near the umbilical margin, and a few shorter ribs are here and there intercalated between the longer ones, where one or more faint and obscure minute riblets can also be detected. On each side of this volution and especially near the aperture, some of the longer ribs are strongly flattened downward at their summits, and widened, sometimes for quite a long distance, longitudinally. On the inner wall of the umbilicus all the ribs are obsolete, and its surface consequently is quite smooth.

Sutural line not well seen, but apparently very similar to that of *P. Otacodensis.*

The largest and best specimen known to the writer, the one figured, is septate throughout, though most of the sutures are either covered by the test, or so badly worn by exposure, that their finer details are completely obliterated. Its dimensions are: maximum diameter, 191 millimetres (or $7\frac{1}{2}$ inches); greatest breadth, 75 mm. (or 3 inches); width of umbilicus, about $47\frac{1}{2}$ mm.

James Island, north of Victoria, V.I., Mr. Fred. Neeves, January, 1888: the fine specimen figured, which has most of the test preserved and upon which the preceding description was based. It was kindly lent to the writer by the Natural History Society of British Columbia.

A crushed and distorted but testiferous specimen, some three inches and a half in its greatest diameter, collected by Mr. A. Raper in 1893 from the Vancouver Coal Company's No. 1 shaft, at Nanaimo, and presented by him to the Provincial Museum at Victoria, is probably referable to this species. Its outer volution is marked by about thirty narrow, transverse but slightly flexuous, simple ribs, with broad flat spaces between them. Some of these ribs extend to the umbilical margin, but others not quite so far.

Hornby Island, W. Harvey (1893, 1894 or 1895): a well preserved specimen, a little more than six inches in its greatest diameter, of a variety of this species in which the ribs are nearly obsolete anteriorly, the outer half of the last volution being almost or quite smooth. This specimen is the property of the Provincial Museum at Victoria.

Sucia Islands, J. Richardson, 1874: a large and well preserved fragment, consisting of about half of one volution, which is not quite four inches and a half in length, by about two and a half in breadth.

P. Neevesii, apparently, has much more numerous and more closely disposed ribs than *P. Otacodensis*, and the outer volution of the former is

more compressed laterally. The fragment of a whorl from the Cretaceous rocks of Saghalien (Sachalin) that Friedrich Schmidt figures under the name *Ammonites planulatus*, * has a very similar kind of ribbing to that of *P. Neevesii*, but the Saghalien specimen is marked also with distinct and distant, periodic constrictions. Dr. Kossmat, who has examined the Sucia Island fragment of *P. Neevesii*, and a good photograph of the James Island specimen, writes that he knows no species with which they could be united.

Pachydiscus Suciensis, Meek. (Sp.).

Ammonites complexus, var. *Suciaensis*, Meek. 1861. Proc. Acad. Nat. Sc. Philad., vol. XIII, p. 317.

Ammonites Brewerianus, Gabb (pars). 1864. Geol. Surv. Calif., Palæont., vol. I, pl. XXVII, figs. 199 and 199 *b*, *c*; and pl. XXVIII, fig. 199 *a*.

Ammonites complexus? var. *Suciaensis*, Meek. 1876. Bull. Geol. and Geogr. Surv. Terr., vol. II, p. 369, pl. V, figs. 2 and 2 *a*, *b*, *c*.

Ammonites complexus, var. *Suciensis*, Whiteaves (pars). 1879. This volume, pt. 2, p. 106; but only the specimen referred to on p. 107, as No. 1, and perhaps that referred to as No. 2.

The original types of *A. complexus*, var. *Suciaensis* are from the Sucia Islands, and Comox, V.I., where they appear to have been collected by Mr. George Gibbs in 1858.

In the second part of this volume, on pages 107 and 108, six of the specimens collected by Mr. Richardson were identified with this species. Of these, No. 1 is clearly a typical specimen of *P. Suciensis*. It is a well preserved cast of the interior of the shell, nearly four inches in its greatest diameter, from the Sucia Islands. No. 2 is a cast of the interior of the outer volution of a large specimen of a species of *Pachydiscus*, from North West Bay, Vancouver Island. Its shape and sculpture are very similar to those of *P. Suciensis*, but its ribs are much more prominent proportionately, though perhaps not more so than would be consistent with its being a well marked variety of that species. Nos. 3, 4, 5 and 6, from the Trent River, V.I., are probably distinct from *P. Suciensis*. Dr. Kossmat, who has seen one of the best of these four specimens, thinks that it may possibly be referable to *P. Newberryanus*, but in each of the four the outer volution is subglobose and much more convex. Outside of the emargination caused by the encroachment of the previous volution, the aperture of these Trent River specimens is wider than high, whereas that of *P. Newberryanus* is much higher than wide. At one time the writer thought that Nos. 3, 4, 5 and 6 were conspecific with the *Ammonites Arrialoorensis* of Stoliczka (erroneously called *A. Deccanensis* on Plate

* On Plate 1, figs. 5 to 7, of volume XIX, of the Mémoires de l'Academie Imperiale des Sciences de St. Pétersbourg, Seventh Series, 1873.

LXIV, fig. 1, of the Cretaceous Cephalopoda of Southern India), but it would now seem that the former are marked with a few distant periodic constrictions as well as ribs, and that the latter is not.

The large specimen figured by Mr. Gabb, as *Ammonites Newberryanus*, on Plates 27 and 28 of the first volume of the Palæontology of California, which he said he obtained on Vancouver Island in the fall of 1863, is now in the Museum of the Academy of Natural Sciences of Philadelphia, and has been kindly lent to the writer, for study, by Dr. H. A. Pilsbry. An actual examination of this specimen has corroborated the view expressed in the second part of this volume that it should be referred, not to *P. Newberryanus*, but to *P. Suciensis*. In this and other specimens of *P. Suciensis* the low, distant ribs are often curiously flattened downward at their summits, for some length on the periphery or siphonal region, but not on the sides.

Several typical and characteristic examples of *P. Suciensis* were collected at Hornby Island, by Mr. Harvey, in 1895 and 1896, and four of these are now in the Museum of the Survey. An unusually fine specimen of the same species, about six inches in its maximum diameter, collected at the Sucia Islands, by Dr. Newcombe, in 1896, and now the property of the Provincial Museum at Victoria, has also been lent to the writer for examination. It shews all the details of the siphonal and first and second lateral lobes and saddles excellently, and has a small portion of the test preserved.

PACHYDISCUS HARADAI, Jimbo.

Pachydiscus Haradai, Jimbo. 1894. Beitr. zur Kenntniss der Fauna der Kreideform, von Hokkaido, in Dames and Kayser's Palæontologische Abhandl., Neue Folge Band II, Heft 3, p. 29, Taf. II, (XVIII) figs. 2, 2*a*, *b*.

" " Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, p. 132, pl. III, fig. 6.

"Nanaimo River, ten miles from its mouth, A. Raper, May, 1893: a fine specimen about six inches in its maximum diameter, which agrees remarkably well with Jimbo's description and figures of *P. Haradai*." "Its volutions are compressed at the sides, the periphery is regularly rounded, and the umbilicus occupies rather less than one-third of the entire diameter. There are eleven large continuous and distant ribs on the outer volution, with from one to four rather smaller and shorter ribs between them, and the intervals between all of them are finely and transversely striated." (Whiteaves, 1896, op. cit. supra.)

The Japanese type of *P. Haradai* is described as measuring 160 mm. (or $6\frac{2}{5}$ inches) in its greatest diameter, and as being marked by about eleven long ribs, bearing a single elongated tubercle on the umbilical

margin on both sides, and with one to three shorter ribs between each pair of the longer ones. In the figure of this specimen, however, the tubercles are represented as obscure and ill defined on some of the ribs and as quite obsolete on the others.

Pachydiscus (Haradai? var.) perplicatus.

Plate 48, fig. 1.

Shell apparently very similar to that of *P. Haradai* in general form, but with its surface marked by much larger and more prominent transverse ribs, or coarse rib-like folds, with more deeply concave grooves between them. The only specimen that the writer has seen is a well preserved cast of the interior of the shell of a specimen, with a little more than the whole of one side worn away, except at A, where part of the siphonal region is preserved. The portion that remains is about six inches and a half in its greatest diameter, and the specimen, when entire, was probably rather more than seven inches in diameter. Its outer volution is marked by fourteen long and slightly flexuous, simple ribs, or rib-like folds, with usually one, but occasionally two, shorter ribs intercalated between each pair of the longer ones. These latter are narrowest, most prominent and abruptly truncated at the umbilical margin, but broader and not so prominent on the periphery. The six nearest to the aperture average from a little less than an inch to an inch and a quarter apart, measuring from the middle of their summits and near to the periphery. Septation unknown.

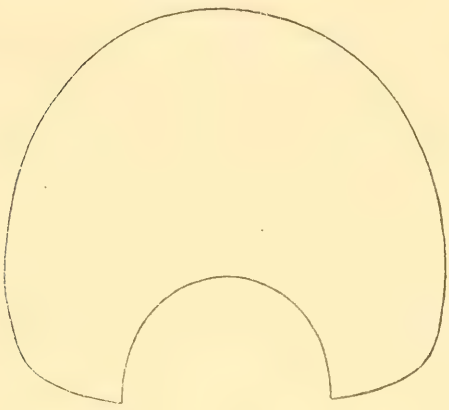


Fig. 22.—*Pachydiscus* (*Haradai?* var.) *perplicatus*. Outline of transverse section of the outer volution, at A, the only place where any part of the siphonal region is preserved, and *between the ribs*, of the specimen from the Comox River represented on Plate 48.

Comox River, near Comox, V.I., J. R. Bennett, 1896 : one specimen, which he has kindly presented to the Museum of the Survey.

Some of the long ribs seem to bear a low, conical, and transversely elongated tubercle on the umbilical margin, but this appearance is partly

due to the abrupt truncation of the ribs there. It is doubtful whether this specimen should be regarded as a well marked variety of *P. Haradai*, or as the type of a distinct and previously undescribed species.

Pachydiscus binodatus. (N. Sp.)

Plate 49, figs. 1, & 1*a*.

Shell strongly ribbed and moderately inflated, but depressed in the middle on both sides, the umbilicus occupying a little more than one third of the entire diameter, though its margin is rounded and indistinctly defined. Volutions rather closely involute, more than one half of the inner ones being covered by those which succeed them, increasing rapidly in size, the outer one rounded between the ribs and near the aperture, but subpentagonal upon the ribs, where the siphonal region is broadly flattened, and the sides slightly and somewhat obliquely compressed. Between the ribs, and near the aperture, the outline of a transverse section of the outer volution is not far from circular, but wider than high, and concavely and rather deeply emarginate by the encroachment of the preceding volution; but if taken at the ribs the section is more nearly pentagonal.

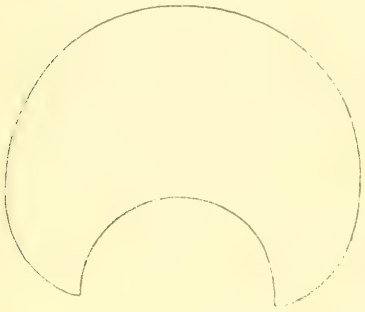


Fig. 23.—*Pachydiscus binodatus.*—Outline of transverse section of the outer volution, *between the ribs* and not far from the aperture, of the specimen from the Comox River, represented on Plate 49.

Surface of the outer volution marked by rather distant, usually simple, but sometimes bifurcating longer ribs which are prominent and concavely curved on the sides, but feebly developed, almost obsolete and nearly straight in the flattened siphonal region, at least near to the aperture. All of these longer ribs extend to, or commence at, the umbilical margin, and alternate with one or two shorter ones. On the outer portion of the last volution each rib bears two large obtusely conical nodes, one on each side of the periphery or venter, at the ventrolateral angle.

Sutural line apparently like that of a typical *Pachydiscus*, as figured by Zittel in the second volume of his Handbuch der Palæontologie.

Comox River, near Comox, V.I., W. Harvey, 1893: a well preserved cast of the interior of the shell, about four inches in its maximum diameter, the property of the Provincial Museum at Victoria.

The pair of large nodes on the ventrolateral angles of each rib is the most conspicuous feature of this shell, and one which will readily distinguish it from all the described American species of *Pachydiscus*. Dr. Kossmat, who has seen the type specimen from Comox, thinks that it is quite distinct from any Indian or European species known to him, and that it is one of the most peculiar types of *Pachydiscus* in the Vancouver Cretaceous.

B.—Aberrant species, in which the cast of the interior of the shell is usually marked with transverse periodic constrictions.

PACHYDISCUS NEWBERRYANUS, Meek. (Sp.)

Ammonites Newberryanus, Meek. 1857. Trans. Albany Inst., vol. IV, p. 47 (not *A. Newberryanus*, Gabb, 1864, Geol. Surv. Calif., Palæont., vol. I, p. 61, pl. 27).

" " Meek. 1876. Bull. Geol. and Geog. Surv. Terr., vol. II, p. 367, pl. 41, figs. 3, 3 *a*, *b*.

" " Whiteaves. 1879. This volume, pt. 2, p. 109, pl. 15, figs. 1 & 1 *a*.

Desmoceras Newberryanum, Whiteaves. 1893. Trans. Royal Soc. Canada for 1892, vol. X., sect. IV, p. 114.

Pachydiscus Newberryanus, Stanton. 1896. Bull. U.S. Geol. Surv., No. 133, p. 16.

The original type of *Ammonites Newberryanus* is from Nanaimo, V.I., where it appears to have been collected by Mr. J. M. Turner in 1856. The specimen described and figured under that name by Meek in the Bulletin of the Geological and Geographical Survey of the Territories is from Comox, V. I., and was probably collected there by Mr. George Gibbs in 1858. It is said to be "2·28 inches in its greatest diameter" and its surface markings are thus described: "Surface ornamented by distinct rounded costæ, which occasionally bifurcate near the umbilicus, and about half-way across toward the periphery, in crossing which they curve slightly forward; depressions between the costæ generally about equaling the latter in size, but at intervals of about five or six times to each turn, a deep sulcus or constriction is seen on internal casts, produced by the occasional thickening of the lip, at regular intervals of about every fifth of each turn. A single row of small transversely elongated nodes surrounds the umbilicus."

1.—Typical form, in which the periodic constrictions are well defined.

On Vancouver Island, specimens that are apparently referable to the typical form of this species were collected by Mr. Richardson, at Brown's River (a tributary of the Puntledge or Comox River), and the lower part of the Trent River, in 1871, and at North West Bay in 1873; also by Mr. Harvey, on the Nanaimo River, in 1901. Similar specimens have

been collected at the Sucia Islands by Mr. Richardson, Dr. Newberry and Dr. Newcombe. The largest specimen in the Museum of the Survey is eighteen inches across, as already stated, on page 110 of this volume.

Dr. Kossmat writes that the septa of *A. Newberryanus* are "certainly not the septa of a *Desmoceras*." and adds that the specimens from Cumshewa Inlet, in the Queen Charlotte Islands, originally referred to *Ammonites Beudanti* on page 205 of this volume, and subsequently called *Desmoceras (Puzosia) Dawsoni* on page 286 of the same volume, are typical examples of the genus. But, in the second volume of his "Handbuch der Palæontologie" all that Zittel says of the sutural line of *Pachydiscus* is, that it is only a little less finely incised than that of *Haploceras* or *Desmoceras*. And, it would be difficult to find an Ammonite that has a more finely or more frequently incised sutural line, than *Pachydiscus Suciensis*.

As already stated, on pages 344 and 345, it is probable that the four Ammonites from the Trent River, collected by Mr. Richardson, and referred to on page 208 of this volume as *Ammonites complexus*, var. *Suciensis*, specimens Nos. 3, 4, 5 and 6, may rather indicate an unusually globose or subglobose form of *P. Newberryanus*.

2.—Abnormal form, in which there are no periodic constrictions on the cast of the interior of the shell.

Shopland, near Maple Bay, Cowitchan district, about thirty miles south of Nanaimo, V.I., a well preserved and nearly perfect cast of the interior of the shell, about ninety-eight millimetres or nearly four inches in its greatest diameter. On the outer volution of this specimen thirteen of the ribs are rather larger, more prominent, and longer than the rest, and between each pair of the larger ribs there are from one to four smaller ones. Two similar but not quite so well preserved specimens in the Museum of the Survey were collected on the Nanaimo River by Mr. Harvey in 1901, but one of these shows two periodic constrictions at a short distance from the aperture.

Pachydiscus multisulcatus. (N. Sp.)

Plate 50; the only figure.

Shell inflated, but very slightly compressed at the sides; umbilicus occupying about one-third of the entire diameter, its margin rounded and its inner wall rather steep. Volutions increasing rather rapidly in size, somewhat closely embracing, about one-half of each of the inner ones being covered; aperture nearly as wide as high, widely subovate, but concavely emarginate by the encroachment of the preceding volution.

Surface marked with comparatively distant, large and prominent, but rather narrow, subangular, more or less acute and slightly flexuous transverse ribs, of unequal length also by a few transverse constrictions, representing periodic arrests of growth. The longer ribs, which extend on both sides to the umbilical margin, often bifurcate at about the middle of each side, but some of them are simple. On the outer volution of the best specimen known to the writer, there are twenty-six of these longer

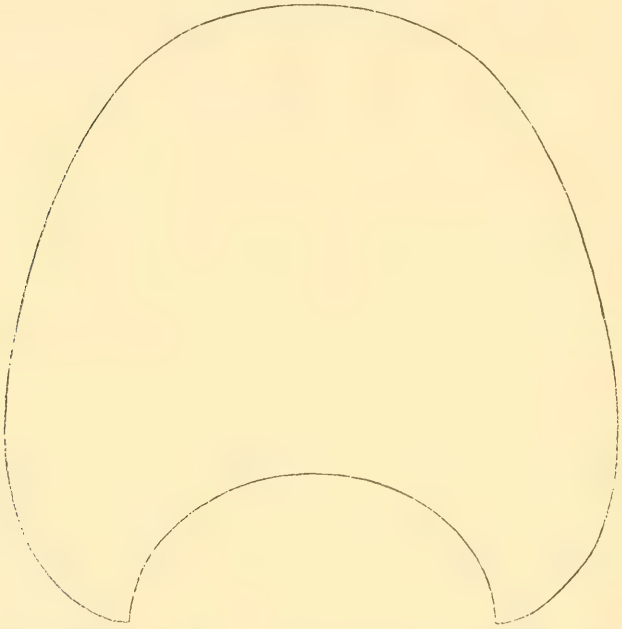


FIG. 24.—*Pachydiscus multisulcatus.* Outline of transverse section of the outer volution, between the ribs and near the aperture, of the specimen from North West Bay, V.I., represented on Plate 50.

ribs, and six or seven periodic constrictions. A single shorter rib is usually intercalated between each pair of the longer ribs, but in one place there are three of the shorter ribs between two of the longer ones. All the ribs are separated by widely concave grooves, and on the periphery of the specimen figured, between the last pair of constrictions, the ribs average from eleven to fourteen millimetres apart, at their summits. The periodic constrictions are not very conspicuous, but are usually a little deeper than the ordinary grooves between the ribs.

Sutural line unknown, only a small part of the septation being visible in either of the specimens known to the writer.

Among the specimens that were referred to *Ammonites Newberryanus* in the second part of this volume, two of the ten from North West Bay, V. I., that were collected by Mr. Richardson in 1873, are said (on page 110) to "differ from the rest in some rather important particulars." One of these specimens, the original of the figure on Plate 50, measures about seven inches and a half in its maximum diameter. It is almost perfect and fairly well preserved on one side, but badly water worn on the other. The other specimen is a large water worn fragment with the finer details of most of its surface ornamentation completely obliterated. The more perfect of these two specimens, at any rate, seems to differ from *P. Newberryanus*, not only in its more inflated volutions, but more particularly in its higher ribs, with much broader grooves between them. Dr. Kossmat, who has seen a good photograph of this specimen, thinks that it belongs to a species allied to *P. Newberryanus*, from which it differs in "its smaller degree of involution (only one half) and the less numerous and more prominent ribs." Judging from the photograph, he adds, "it seems to me that the constrictions are more strongly bent forward than the ribs behind them, so that they have the tendency to cut off one of the ribs. This character is not observed in *P. Newberryanus*." Quite recently, in October, 1901, an imperfect but characteristic specimen of this species, about five inches in its greatest diameter, was collected two miles and a half up the Nanaimo River, V.I., by Mr. Harvey.

Desmoceras Selwynianum, Whiteaves.

Ammonites Selwynianus, Whiteaves. 1879. This volume, pt. 2, p. 104, pl. 13, figs. 1, and 1*a*.
Desmoceras Selwynianum, Kossmat. 1897. Beitr. zur Palæont. Oesterreich-Ungarns und des Orients, vol. XI, p. 148.

Sucia Islands, Dr. C. F. Newcombe, 1894: two specimens. West side of Denman Island, half a mile south of Village Point, W. Harvey, 1896: two small specimens, the largest not quite forty-nine millimetres, or nearly two inches in it greatest diameter.

One of the original types of *Ammonites Selwynianus*, from the Sucia Islands, has been kindly compared by Dr. Kossmat with Indian specimens of *A. diphylloides*, Forbes, of which it was thought possible that it might be a variety. In regard to this specimen, Dr. Kossmat wrote as follows:—"*A. Selwynianus* is a near ally of the S. Indian *A. diphylloides*, which is clearly a *Desmoceras*, as shown by its septa. Allied species of *Desmoceras* occur in Europe also, for example *D. pyrenaicum*, Grossouvre (Ammonites de la Craie Superieure, Paris, 1893, pl. XXXVII, fig. 9), in the Senonien of France. The septa can only partially be seen on the specimen sent by you, but they are certainly very similar to those of *D. diphylloides*. An important difference between the two species is the very

narrow tongue-like process of each constriction, on the external side of *A. Selwynianus.* In *A. diphylloides* these processes are much more rounded." These conclusions, it will be seen, are essentially similar to those previously arrived at by the writer in 1879, and expressed on page 105 of this volume.

Pleuropachydiscus Hoffmannii (Gabb). Var.

Ammonites Hoffmannii, Gabb. Var. 1869. Geol. Surv. Calif., Palæont., vol. II, p. 131, pl. 20, figs. 8 and 8 *a*.

Desmoceras Hoffmannii, Stanton. 1897. Journ. Geol. Chicago, vol. V, pp. 597 and 598.

Pleuropachydiscus Hoffmanni, Hyatt. 1900. In Eastman's transl. of Zittel's Text Book of Palæontology.

A well preserved and testiferous fragment of an Ammonite collected at the Sucia Islands by Dr. Newcombe in 1896, seems to be identical with the variety of *A. Hoffmannii*, from Cottonwood Creek, that Gabb describes on pages 131 and 132 of the second volume of the Palæontology of California, and figures on Plate 20 of that volume, though it is not very much like the typical form of that species. In the Sucia Island fragment the volution is not quite so wide as high, and the surface ornamentation consists of very small, flexuous, transverse ribs, with a comparatively large rib interposed at distant intervals. Between two of these larger ribs there are about twenty-five of the smaller.

Hauericeras Gardeni (Baily).

Ammonites Gardeni, Baily. 1855. Quart. Journ. Geol. Soc. London, vol. II, p. 456, pl. II, fig. 3.

" " Stoliczka. 1865. Cret. Cephal. S. India, p. 61, pl. 33, fig. 4.

" " Whiteaves. 1879. This volume, pt. 2, p 102.

Desmoceras Gardeni, Zittel. 1884. Handbuch der Palæont., Band II, p. 466.

" " Yokoyama. 1890. Versteiner. aus der Japanische Kreide, Palæontographica, vol. XXXVI, p. 184, pl. XX, figs. 10, *a*, *b*, *c*.

Desmoceras (Hauericeras) Gardeni, Kossmat. 1897. Beitr. zur Palæont. Oesterreich-Ungarns und des Orients, vol. XI, p. 123, pl. XVIII, figs. 7, 8 and 10.

Puntledge or Comox River, at Comox, V.I., Dr. C. F. Newcombe, 1892, two specimens, one of them a well preserved cast of the interior of the chamber of habitation; and J. B. Bennett, 1894 or 1895, four specimens. Trent River, V.I., W. Harvey, 1896, one specimen and a fragment; Nanaimo River, W. Harvey, 1901, two specimens; all determined by the writer.

Of two of these specimens from Comox, Dr. Kossmat wrote as follows: "The Vancouver specimens of *D.* (*H.*) *Gardeni* agree perfectly with the

S. African types and the S. Indian specimens compared by me. Section, sculpture, involution, constriction, sutural line, are quite the same in all. The body-chamber which you have sent is distinguished by its very deep constriction (quite similar, deep constrictions are visible in S. African specimens although they are not figured) and by its narrow mouth."

H. Gardeni is now known to occur in the Upper Cretaceous rocks of Japan. It had previously been collected from rocks of the same age in Natal, Southern India, and Vancouver Island.

Gasteropoda.

Cylichna costata, Gabb.

Cylichna costata, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. i, p. 143, pl. 21, fig. 107.

In 1901, a few specimens that are probably referable to this species were collected at Brennan Creek, near Wellington, by the Rev. G. W. Taylor, and from the roof of the coal at the New Vancouver Coal Co's. mine, Nanaimo, by Mr. Harvey. These specimens may be described as follows:

Shell small, subcylindrical, narrowly elongated and nearly twice as long as broad, when full grown; spire sunk, its position indicated by a deep, narrow pit; aperture rather narrow posteriorly, wider anteriorly; posterior end of the outer lip projecting slightly beyond that of the previous volution and very narrowly rounded at its junction with the columellar lip.

Test thin, surface smooth and polished, but encircled with numerous revolving incised lines or minute linear spiral grooves, which are usually much narrower than the spaces between them. Under a rather powerful simple lens, each of these incised lines is seen to consist of a single, regular row of minute punctures, like those represented by figure 8*b*, on Plate 16, of the second part of this volume, and the whole of the rest of the surface to be still more minutely and longitudinally striated.

Approximate dimensions of the largest specimen that the writer has seen: maximum length, not quite nine millimetres; greatest width, five mm.

These specimens have the same kind of sculpture as those referred to on page 132 of the second part of this volume, with a query, as possibly a variety of *Bulla Hornii*, Gabb, under the name *Haminea Hornii*, but the former are much more narrowly elongated.

It is possible, also, that the specimens collected by Mr. Richardson, at Blunden Point, V.I., and at Hornby Island, that were doubtfully referred to *Bulla Hornii*, may rather be referable to *Cylichna costata*. Those from Admiralty and the Sucia Islands, collected also by Mr. Richardson, are, however, shorter and wider in proportion to their length, and these are very similar to *Bulla Hornii*, as figured by Gabb, much more so than figure 8, on Plate 16, of the second part of this volume would leave one to infer. It is not at all likely that Gabb's typical *B. Hornii* is a true *Bulla*, as that genus is now restricted. The specimens from the Admiralty and Sucia Islands that have been identified therewith may be referable to *Cylichna* rather than to *Haminea*, and may indeed prove to be only a short and wide form of *C. costata*.

Cinulia obliqua, Gabb.

Cinulia obliqua, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 111, pl. 19, figs. 64, and 64 *a*, *b*, *c*.
" " Whiteaves. 1879. This volume, pt. 2, p. 131.
" " White. 1889. Bull. U.S. Geol. Surv., No. 51, p. 45.

Specimens which are obviously referable to this common species were collected at the Sucia Islands by Dr. Newcombe in 1894 and 1896; at Brennan Creek, V.I., by the Rev. G. W. Taylor in 1901; and on the Nanaimo River, two and a quarter to ten or twelve miles from its mouth, by Mr. Harvey in 1901.

Trochactæon semicostatus. (N. Sp.)

Plate 44, fig. 5.

Shell very small, narrowly subovate or ovately subcylindrical, fully twice as long as wide, with a short, angularly step-shaped spire, and narrowly rounded base. Spire composed of four volutions; outer volution shouldered above, widest at and for a short distance below the shoulder and narrowing gradually into the narrowly rounded or somewhat pointed base, or termination anteriorly.

Surface marked with numerous minute and close-set ribs, that cross the volutions transversely but become obsolete at the base of the outer volution. These ribs can only be seen with the aid of a lens, and are merely indicated in the figure.

Roof of coal, New Vancouver Coal Co.'s mine, Nanaimo, V.I., W. Harvey, 1901: six fairly well preserved but imperfect or distorted specimens, the largest of which is not quite six millimetres long.

This is a much smaller species than the *T. cylindraceus?* (or *T. Skidegatensis*) of the Cretaceous rocks of the Queen Charlotte Islands, with a distinctly step-shaped spire, and very minute ribs that evanesce on the outer volution anteriorly.

Zittel, in his 'Handbuch der Palæontologie,' regards *Trochactæon*, Meek, as a synonym of *Actæonella*, d'Orbigny, and Dr. Paul Fischer, in his Manuel de Conchyliologie, says that it indicates a mere section of that genus.

Surcula (raricostata? var.) Hornbyensis.

Surcula raricostata, Gabb, var. Whiteaves. 1879. This volume, pt. 2, p. 116, pl. 15, figs. 2 and 2 *a*.

The five specimens from Hornby Island that are referred to in the second part of this volume as a variety of *S. raricostata*, are probably distinct therefrom, and it seems desirable to distinguish the Canadian from the Californian specimens by a local and at least varietal, if not specific name.

Bela cretacea. (N. Sp.)

Plate 44, fig. 6.

Shell small, angularly subfusiform, and about twice as long as wide, spire shorter than the outer volution; whorls five, the third and fourth obliquely compressed above, laterally compressed below, and subangular at about their mid-height; the outer one moderately convex, obliquely compressed next to the suture, subangular and most prominent considerably above its mid-height, thence tapering abruptly and rapidly into the narrow, nearly straight and channeled base.

Surface marked with flexuous nodose ribs and raised lines of growth, that cross the volutions transversely and run parallel with the outer lip, also by numerous, close-set, minute and rounded spiral ridges. The ribs are most prominent and distinctly nodose on the spiral angulation or shoulder of the later volutions, and the nodes, when examined with a lens, are seen to be obtusely conical and laterally compressed.

Hornby Island, W. Harvey, 1895: two specimens, both of which are now in the Museum of the Survey. The figured specimen, which is the more perfect of the two, is about ten millimetres in length.

Rostellites Gabbi, White. (Sp.)

Volutilithes Navarroensis, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 102, pl. 19, fig. 56; but, according to Dr. C. A. White, not *V. Navarroensis*, Shumard, 1861.

Rostellites Navarroensis, Conrad. 1865. Amer. Journ. Conch., vol. I, p. 363.

Fulguraria Navarroensis, Whiteaves. 1879. This volume, pt. 2, p. 117, pl. 15, figs. 3 and 3 *a*.

Fulguraria Gabbi, White. 1889. Bull. U. S. Geol. Surv., No. 51, p. 23, pl. III, fig. 1.

Rostellites Gabbi (White) Dall. 1890. Trans. Wagner Free Instit. Sc. Philad., vol. III, p. 71.

Sucia Islands, Dr. Newcombe, 1894, one specimen; Brennan Creek, V.I., Rev. G. W. Taylor, three specimens; and New Vancouver Coal Co's. Mine, Nanaimo, V.I., W. Harvey, 1901, one specimen.

Fusus Kingii, Gabb.

Fusus Kingii, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 85, pl. 28, fig. 204.
" " Whiteaves. 1879. This volume, pt. 2, p. 119, pl. 15, fig. 4.
" " White. 1889. Bull. U.S. Geol. Surv., No. 51, p. 46.

Sucia Islands, Dr. Newcombe, 1894 or 1896: one specimen.

Perissolax brevirostris, Gabb.

Plate 43, fig. 3.

Perissolax brevirostris, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 91, pl. 18, fig. 43.
" " Whiteaves. 1879. This volume, pt. 2, p. 121.
" " White. 1889. Bull. U.S. Geol. Surv., No. 51, p. 46.

Hornby Island, W. Harvey, 1895: a young specimen. Sucia Islands, Dr. Newcombe, 1894 or 1896: the nearly adult and well preserved specimen figured, in which, however, no part of the outer lip is shewn,—and two smaller ones. Quarry on Protection Island, W. Harvey, 1901: three imperfect but fairly characteristic specimens. Brennan Creek, V. I., Rev. G. W. Taylor, 1901: three specimens.

In the first volume of the American Journal of Conchology, published in 1865, and on page 363, Conrad says that the genus *Perissolax* is "peculiar to the Eocene formation" and that *P. brevirostris* is "not a member of the genus, to which it is somewhat doubtfully referred by Mr. Gabb." Dr. Paul Fischer, in his Manuel de Conchyliologie, makes *Perissolax* a subgenus of *Tudicla*.

Hindsia nodulosa, Whiteaves.

Plate 43, fig. 2.

Fasciolaria nodulosa, Whiteaves. 1874. Geol. Surv. Canada, Rep. Progr. for 1873-74, p. 268, pl. of fossils, figs. 7 and 7*a*, but not 7*b*.

Hindsia nodulosa, Whiteaves. 1879. This volume, pt. 2, p. 125, pl. 15, figs. 6 and 7.

Sucia Islands, Dr. Newcombe, 1896: the specimen figured, which shews the characters of the aperture unusually well. The inner lip shews a thick and comparatively broad deposit of callus or enamel, and two small transverse plicæ. The inner surface of the thickened outer lip has two comparatively large, median denticles, and a small posterior denticle.

Brennan Creek, V. I., Rev. G. W. Taylor, 1901: two specimens that are apparently referable to this species.

Sycodes glaber, Shumard. (Sp.)

Pyrula glabra, Shumard. 1858 (?) Trans. Ac. St. Louis for 1857, vol. I, p. 125.

Ficus cypræoides, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 115, pl. 19, fig. 58.

Sycodes cypræoides, Gabb. 1869. Idem, vol. II, pp. 160 and 221.

Sycodes glaber, Whiteaves. 1879. This volume, pt. 2, p. 125.

Sucia Islands, Dr. Newcombe, 1894 or 1896: two specimens. It is, however, just possible that the specimens from Vancouver and the Sucia Islands that have been referred to this species, may prove to be immature examples of the next.

Cypræa Suciensis, Whiteaves.

Cypræa Suciensis, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 127, pl. III, fig. 5.

Original description.—"Shell small, moderately inflated, narrowly subovate and a little more than half as broad as long, emarginate at both ends, but much more deeply so posteriorly than anteriorly. Spire entirely covered when the outer coating of enamel is perfect, but in the only specimen collected the enamel is partially exfoliated in such a way as to show that underneath it the spire is very small, conical, and composed of at least four volutions, also that it extends just as far backward as the produced posterior end of the outer lip. This partial exfoliation of the outer layer of enamel is, however, barely perceptible to the naked eye, and is not shown in the figure. Outer volution very large in proportion to the rest, broadest and most inflated a little behind the mid-length, abruptly attenuate behind, but narrowing much more gradually in front, its anterior margin being narrowly rounded; outer lip thickened exte-

riorly and considerably produced behind; inner or columellar lip also produced behind and separated from the outer lip by a narrow channel or canal; characters of the interior of the aperture unknown, though it clearly extended the whole length, and is narrow and linear behind.

"Surface smooth.

"Dimensions of the specimen described (which has been kindly presented by its discoverer to the Museum of the Geological Survey): length, twenty millimetres; greatest breath, twelve millimetres.

"Sucia Islands, Dr. C. F. Newcombe, 1894.

"Most of the aperture of this interesting little fossil is filled with the tough and tenacious matrix, so that it is impossible to ascertain whether there are or are not any crenulations on the inner surface of the outer lip, or any denticulations or plications on the columellar side. The external characters of the specimen, however, would seen to show that it is a small smooth *Cypræa*, very closely allied to the *C. Cunliffei* of Forbes, * from the Arrialoor group of the Trinchinopoly district of Southern India, and it may prove to be only a variety of that species. The *Cypræa Bayerquei* and *C. Mathewsoni*, described in the first and second volumes of the Palæontology of California, as from the Tejon group of that state, are now generally regarded as Eocene fossils."

Tessarolax distorta, Gabb.

Tessarolax distorta, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 126, pl. 20, figs.
" " 82 and 82, *a-b*.
" " Whiteaves. 1879. This volume, pt. 2, p. 123.
" " Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. 1, sect. IV, p. 127.

Several much finer specimens of this singular species than the one obtained by Mr. Richardson in 1871, were collected at Hornby Island by Mr. Harvey, in 1894, 1895 and 1897, and most of these are now in the Museum of the Survey.

Anchura callosa. (N. Sp.)

Anchura stenoptera, Whiteaves. 1879. This volume, pt. 2, p. 123, pl. 15, figs. 11 and 11 *a*; but probably not *Rostellaria stenoptera*, Goldfuss (1844.)

Shell fusiform, spire elongated, turreted, slender, outer volution expanded and alate, though the exact shape of the alation is not shown in the only specimen that the writer has seen. Volutions eight or nine,

*Transactions of the Geological Society of London, vol. VII (1846), p. 134, pl. 12, fig. 22; and Stoliczka (1868) Cretaceous Cephalopoda of S. India, vol. II, p. 55, pl. 4, fig. 4.

those of the spire rounded, but slightly compressed laterally, the outer one somewhat inflated, but obliquely flattened next to the suture, subangular and lightly shouldered a little behind its midheight or midlength, and narrowing rapidly to the base anteriorly; outer lip expanded and alate, its posterior margin, the only part of the wing that is clearly shewn, being broadly and shallowly concave; columella incrusted by a large callus, which forms quite a thick rounded projection anteriorly.

Surface marked by rather distant, obtuse and not very prominent plications or rib-like folds, which cross all the volutions transversely and are themselves crossed by numerous small acute, spiral ridges, the shoulder of the outer volution being distinctly nodose.

The foregoing is a description of the imperfect specimen from the Trent River, figured, of the natural size, on Plate 15 of the second part of this volume. This specimen was referred by the writer to the *Rostellaria stenoptera* of Goldfuss, but this reference seems to be no longer tenable. In the Canadian specimen the whorls can scarcely be described as minutely and spirally striated, the ribs on the last volution are not all strongly granulated, and it is by no means certain that its wing, when entire, was narrow and sword shaped. Moreover it does not seem probable that a fossil from the Nanaimo group of the Vancouver Cretaceous is identical with a species from the Upper Greensand of Westphalia. For these reasons it is now thought desirable to distinguish the specimen from the Nanaimo River by a new specific name.

Among the fossils of the California Cretaceous, *Anchura transversa* of Gabb * would seem to come nearest to *A. callosa*, but the former is represented as being wider than long, and of comparatively diminutive size *i. e.*, only ten millimetres in length, by thirteen mm. in width.

Mesostoma Suciense. (N. Sp.)

Plate 44, fig. 7.

Cerithium Lallierianum, var. *Suciense*, Whiteaves. 1879. This volume, pt. 2, p. 122, pl. 15, figs. 10 and 10 *a*; but apparently not a true *Cerithium*, nor a var. of the *C. Lallierianum* of d'Orbigny and other European authors.

Shell imperforate, elongated and about twice as long as wide; volutions six in the most perfect specimen collected and probably seven when perfect, those of the spire rounded and ventricose: suture well defined: outer volution strongly convex at or about its midheight, narrowing abruptly into the rounded base below: aperture broadly and

*Geological Survey of California, Palæontology, volume II, p. 165, pl. 27, fig. 45.

obliquely suboval or subovate, longer or higher than wide, and narrowest behind, entire, not channelled anteriorly as in *Cerithium*; outer lip simple, inner lip thickened and somewhat reflected or expanded at the base.

Surface marked by narrow, but prominent and rather distant, varix-like ribs, that cross the volutions transversely, and that are themselves crossed by smaller and closer spiral ridges, the points of intersection being minutely tuberculate.

Protection Island, J. Richardson, 1873: "a single and not very perfect individual". Sucia Islands, J. Richardson, 1874: "six well preserved examples." The largest of these specimens is a little more than sixteen millimetres in length. Similar specimens were collected at the Sucia Islands by Dr. Newcombe in 1894 and 1896, and at the Nanaimo River, by Mr. Harvey, in August, 1901. In the figure on Plate 15 of the second part of this volume the number of volutions is represented as eight, but the apical ones are slightly restored. The characters of the aperture are well shewn in the specimen represented by figure 7 on Plate 44.

The reference of the specimens collected by Mr. Richardson to the genus *Mesostoma* (Deshayes, 1861) was first suggested by Dr. Stanton, in 1893, in his memoir on "The Colorado formation and its Invertebrate Fauna," published as Bulletin No. 106 of the U. S. Geological Survey.

Mesostoma (?) intermedium. (N. Sp.)

Plate 43, fig. 4.

Shell imperforate, elongate, slender; volutions nine, those of the spire obliquely flattened and very slightly convex; the last volution moderately inflated at about its midheight and narrowly rounded below; aperture higher than wide, subovate and abruptly pointed posteriorly; outer and inner parts of the lip unknown.

Surface marked by numerous, narrow, rib-like folds, that cross the volutions transversely, and by smaller and still more numerous spiral ridges.

Sucia Islands, Dr. C. F. Newcombe, 1894: four fairly good specimens and one fragment. One of these is twenty-nine millimetres long and has seven volutions preserved. Another was probably about forty millimetres in length, when entire. Brennan Creek, V.I., Rev. G. W. Taylor, 1901: one good specimen and two fragments. The former is only seventeen millimetres long, but has eight volutions well preserved, and there was probably one more at the apex.

This species seems to differ from *M. Suciense* in its uniformly larger size, less ventricose volutions, and perhaps also in its somewhat finer and

less prominent rib like folds. As its mouth characters are almost entirely unknown, it is by no means certain that it belongs to the genus *Mesostoma*.

Mesostoma (?) Newcombii. (N. Sp.)

Plate 43, fig. 5.

Shell elongated, slender, more than twice as long as wide; volutions nine or ten, slightly and rather obliquely compressed above or posteriorly, most prominent and rounded below their midheight anteriorly; outer volution short, apparently rounded at its base; characters of the aperture unknown, though the outline of a transverse section of the interior of the last volution near the aperture is obliquely oval.

Surface marked with rather large, low, distant, rounded rib-like folds, that cross the lower part of each volution transversely and are obsolete above, also by numerous, very small and close set spiral ridges.

Approximate dimensions of the only specimen known to the writer, which is slightly imperfect at both ends: length, sixty-six millimetres; greatest breadth, twenty-five mm.

Sucia Islands, Dr. C. F. Newcombe, 1896: one specimen.

Apparently a much larger species than the preceding, with volutions of a different shape, and with different surface markings. It is, however, quite doubtful to what genus this shell should be referred, and it is only provisionally regarded as a *Mesostoma*.

Cerithium Vancouverense. (N. Sp.)

Plate 43, fig. 6.

Shell small, elongated, slender, apex apparently acute, volutions probably about eight or nine, though only six are actually preserved in the best specimen that the writer has seen, and compressed laterally; spire rather more than twice as long as the outer volution, which is also compressed at the sides, and narrowly rounded at the base or anteriorly; characters of the aperture unknown.

Surface marked by strongly defined, straight ribs, that cross the volutions of the spire and upper half of the outer volution transversely, and by spiral rows of small, spirally elongated tubercles. As viewed dorsally, there are four rows of these tubercles on the later volutions of the spire, and on the outer volution there are three or four rows of tubercles above the midheight, and six or seven small spiral ridges without tubercles below.

Extension mine, near Nanaimo, V. I., W. Harvey, 1901 : the specimen figured, which is twelve millimetres long and imperfect at both ends, and a fragment of another. These specimens seem to differ from *C. Skidegatense* in their larger size, more slender spire, and spirally elongated tubercles, but they may represent only a large stratigraphical and geographical variety of that species. In the original description of *C. Skidegatense*, in the third part of this volume, no mention is made of any ribs. Yet of the five specimens from Maud Island upon which the species is based, two shew that all the volutions of the spire are crossed by transverse and straight ribs, that become obsolete and disappear on the lower half of the outer volution.

Cerithium Harveyi. (N. Sp.)

Plate 43, fig. 7.

Shell elongated, more than twice as long as wide; volutions about seven, those of the spire obliquely compressed laterally, and pentagonal in transverse section; outer volution moderately convex, widest at or a little above its midheight, as viewed dorsally, and abruptly narrowing into the channeled base anteriorly; characters of the aperture unknown.

Surface marked by distant variciform ribs, that cross the volutions transversely, with broad nearly flat or shallowly concave spaces between them, and by small beaded or minutely tuberculated spiral ridges. On the last volution but one there are four of these beaded spiral ridges, and on the last there are six spiral ridges and five variciform ribs. These latter are nearly or quite opposite on three or four of the volutions, and are continuous longitudinally for the greater part of the length of the specimen.

Roof of coal, New Vancouver Coal Co.'s mine, Nanaimo, W. Harvey, 1901 : two specimens, one, which is somewhat crushed, not very well preserved and slightly imperfect at both ends, being twenty-four millimetres in length by ten millimetres in breadth; while the other, which is figured, is more perfect and better preserved, being about thirteen millimetres long.

The writer has much pleasure in associating with this species the name of its discoverer, Mr. Harvey, whose long continued exertions have added so many novel forms to the fauna of the Vancouver Cretaceous.

Potamides tenuis, Gabb.

Potamides tenuis, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 130, pl. 20, fig. 86.
" " Whiteaves. 1879. This volume, pt. 2, p. 121, pl. 15, figs. 8 *a*, 8 *a*, *b*.

The references to this species on page 121 of the second part of this volume are somewhat unfortunate. For, in the first place, the two specimens from the "Middle Shales," one of which is figured, are from the north-west side of Hornby, not of Denman Island. And in the next place, the two (not three) very small and imperfect specimens from the "Lower Shales" of Denman and the Sucia Islands, prove to be quite distinct from *P. tenuis*. In Canada, so far as the writer is aware, the typical form of the species, as distinct from the var. *Nanaimoensis*, has been collected only at Hornby Island, by Mr. Richardson, in 1872; at the Sucia Islands, by Dr. Newcombe, in 1894; and from the roof of the coal, Nanaimo mines, V. I., by Mr. Harvey, in 1901.

In specimens of *P. tenuis* from the Chico group of Pences Ranch, California, the typical locality, kindly lent to the writer for comparison by Dr. Stanton, there are eight volutions. The later ones of the spire are each marked with a spiral row of distant obtusely conical nodes, on the angle near the base, but upon the outer volution these nodes are almost or completely absent. The nodes, also, are much smaller in some specimens than they are in others. In those with very small nodes, the whole of the spire and the upper half of the last volution is ribbed longitudinally, that is, in a direction parallel to the main axis, but transversely to each volution. The nodes on the basal angle of the spire of the specimen from Hornby Island, figured on Plate 15 (figure 8) of the second part of this volume, are unusually large, and they are fully developed on the outer volution.

Nerinea dispar ? Gabb. Var.

Nerinea dispar ? Gabb. Var. Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 127, pl. 3, fig. 4.

"Shell essentially similar in shape and surface markings to *N. dispar*, but smaller and devoid of the rounded spiral fold at the base of each volution said to be characteristic of that species, also with the longitudinal ribs apparently obsolete on the lower volutions.

"Hornby Island, W. Harvey, 1894, three specimens. The most perfect of these has seven volutions preserved, with the minute details of the sculpture of each quite clearly shewn. The three upper volutions are marked with small longitudinal ribs that cross the volutions trans-

versely, but on the three lower volutions these ribs appear to be absent, though their absence may be due to the exfoliation of the outer layer of the shell". (Op. cit. supra.)

Capulus corrugatus. (Nom. prov.)

Plate 45, figs. 2 and 2 *a*.

Shell varying in external contour from conical and considerably elevated, with a subcentral, prominent, pointed and slightly incurved apex, to depressed patelliform, with an obtuse apex : aperture large, irregular in outline, varying from nearly circular to widely subovate, but always a little longer than wide.

Surface marked by narrow, concentric, annular wrinkles, and by fine striæ of growth. Muscular impressions unknown.

Puntledge or Comox River, near Comox, V.I. : three specimens, two collected by Mr. Harvey in 1895, and the other by Mr. Bennett in 1896, all of which are now in the Museum of the Survey.

In the absence of any knowledge of their muscular scars, these specimens are only provisionally referred to the genus *Capulus*, on account of their resemblance, in external form and surface markings, to the *C. cassidarius* and *C. annulatus* of Yokoyama, as described and figured in his memoir on the fossils of the Cretaceous rocks of Japan.* The original of figures 2 and 2*a* on Plate 45 of the present publication, which is the most elevated of the three Comox fossils, is not at all unlike the specimen of *C. cassidarius* figured on Plate xviii, figure 10, of the thirty-sixth volume of the Palæontographica, but in the latter the apex is not so much incurved, and the surface is marked only with five annular striæ of growth. Another of the Comox specimens has much the same kind of surface markings as *C. annulatus*, but in the latter the apex is erect, and the annular wrinkles appear to be proportionately more numerous.

On the other hand, these Comox specimens may prove to be the young of a very large species of *Helcion*, recently discovered at Nanaimo, by Mr. Harvey, which will be found described a little farther on in these pages under the name *H. giganteus*, Schmidt, var. *Vancouverensis*. The apex of a very young specimen of the var. *centralis* of *H. giganteus*, figured by Schmidt on Plate iii, figure 9, of his memoir on the fossils of the Chalk formation of Saghalien (Sachalin)† is very like that of the Comox speci-

*Versteinerungen aus der Japanische Kreide, Palæontographica, Bd. xxxvi, p. 177, pl. 18, figs. 10, *a*, *b*, 11, *a*, *b* ; and p. 200, pl. 25, figs. 17, *a*, *b*.

†In the "Mémoires de L'Académie Impériale des Sciences de St.-Pétersbourg," viie Serie, Tome xix, No. 3, pp. 1—37.

men figured in this publication, but the former shews clearly the commencement of the radiating rib-like folds which characterize the adult shell, and the latter does not.

Vanikoro pulchella. Var.

Cfr. *Vanikoro pulchella*, Whiteaves. 1884. This volume, pt. 3, p. 215, pl. 27, figs. 4 and 4 *a*.

Shell essentially similar to the type and hitherto only known specimen of *V. pulchella*, and apparently differing therefrom only in its somewhat larger size and coarser transverse plications.

Departure Bay, V.I., W. Harvey, 1901 : a large but worn and imperfect specimen, that measures about seventeen millimetres in height by twenty mm. in width.

Texada Island, W. Harvey, 1901 : a well-preserved but fragmentary specimen, consisting of the spire and upper portion of the outer volution. It is in this specimen that the transverse plications are seen to be larger and more prominent proportionately, than those of the type of the species are.

Both of these specimens, when examined with a lens, are seen to be marked with numerous and irregularly disposed, small circular pits, that may indicate the burrows of a *Cliona*.

Lunatia Shumardiana, Gabb.

Lunatia Shumardiana, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 106, pl. 19, fig. 61.

" " White. 1889. Bull. U. S. Geol. Surv., No. 51, p. 45.

"A single example from Sucia Island apparently belongs to this species." (White.) A specimen from the roof of the coal at the Nanaimo mines, collected by Mr. Harvey, in 1901, and now in the Museum of the Survey, may also be referable to *L. Shumardiana*, though its aperture is filled with the matrix, which completely covers the columellar lip.

Gyrodes (Conradiana ? Gabb, var.) Canadensis.

Gyrodes excavata, Whiteaves. 1879. This volume, pt. 2, p. 124, pl. 16. figs. 2 and 2 *a* ; but probably not *Natica excavata* of Michelin or d'Orbigny.

Gyrodes Conradiana, White. 1889. Bull. U. S. Geol. Surv., No. 51, p. 45.

Shell always much smaller than *Natica excavata* and the typical *G. Conradiana* and differing from the latter also in having the upper edge or margin of the outer volution narrowly truncated and flattened downward

next to the suture above. The largest of the specimens collected by Mr. Richardson is about fourteen millimetres high, and of late years a few additional and similar specimens have been collected at the Sucia Islands by Dr. Newcombe, and at Brennan Creek, V.I., by the Rev. G. W. Taylor.

Amauropsis Suciensis, Whiteaves.

Amauropsis Suciensis, Whiteaves. 1879. This volume, pt. 2, p. 123, pl. 16, fig. 1.

Sucia Islands, Dr. Newcombe, 1894 or 1896 : four or five specimens. Texada Island, W. Harvey, 1901 : one specimen.

Odostomia (?) inornata. (N. Sp.)

Plate 43, fig. 8.

Shell very small, imperforate, elongate, narrowly conical and rather more than twice as long as wide ; spire acute. Volutions about five, those of the spire obliquely flattened ; the outer one moderately convex, not quite as wide as high and a little shorter than the spire, as viewed dorsally, and narrowly rounded at the base or anterior end ; suture very lightly impressed ; aperture apparently subovate, rounded anteriorly and pointed posteriorly, outer lip simple.

Surface smooth.

Approximate dimensions of the specimen figured : maximum length, rather more than three millimetres and a half ; greatest width, nearly one mm. and a half.

Nanaimo River, V.I., ten to twelve miles up, W. Harvey, 1901 : one specimen with the test well preserved. This specimen is in the Museum of the Survey.

Odostomia (?) cretacea. (N. Sp.)

Plate 43, fig. 9.

Shell very small, imperforate, elongate pupiform, slender, more than twice as long as wide. Volutions five, compressed laterally but slightly convex ; spire much longer than the outer volution, its apex obtuse ; suture lightly impressed ; aperture obliquely subovate, longer than wide, narrowly rounded at the base in front and pointed behind ; outer lip apparently simple.

Surface markings unknown.

Approximate dimensions of the specimen figured : length, two millimetres and a half ; width, three quarters of a millimetre.

Brennan Creek, V.I., Rev. G. W. Taylor, 1901 : six specimens, which he has kindly presented to the Museum of the Survey. In each of them the shell substance is decomposed and more or less exfoliated.

Lysis Suciensis, Whiteaves.

Plate 45, figs. 3 and 4.

Stomatia Suciensis, Whiteaves. 1879. This volume, pt. 2, p. 128, pl. 16, figs. 4 and 5.

Typical form.—Sucia Islands, C. F. Newcombe, 1894 : two specimens. One of these, the original of figure 3 on Plate 45, is about forty-three millimetres in height, has the outer surface much worn, and shews little more on the outside than a few distant lines of growth The other, which is about fourteen mm. high, is marked by numerous and close-set minute spiral ridges, as well as by lines of growth. On the inside both shew the "concave expansion of the incrusting layer of the inner lip," which forms such a striking character in the genus *Lysis*, and confirm the suggestion made by Dr. White, in 1889, that the specimens described and figured by the writer under the name *Stomatia Suciensis* "belong to Gabb's genus *Lysis*."*

Var. carinifera.—Brennan Creek, V. I. : two specimens, each with two spiral keels on the outer volution. One of these is a somewhat crushed specimen, some eighteen millimetres high and twenty and a-half wide, the original of figure 4 on plate 45. Its two spiral keels are placed near to each other, just below the mid-height, but on the outer lip each keel, or ridge, is produced into a short, conical, slender spine. The other is a very small specimen, about five mm. high, with the two spiral keels also placed near to each other, a little below the mid-height on the dorsal surface of the last volution. Texada Island, W. Harvey, 1901 : three specimens, each with two spiral keels on the last volution.

Eunema cretaceum, Whiteaves.

Eunema cretaceum, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 126, pl. 3, fig. 3.

Original description and remarks.—"Shell small, imperforate, apparently elongate turbinate, with the spire about equal in height to the outer volution, as viewed dorsally, though the few specimens collected so far are so crushed that their exact original shape is uncertain. Volutions five or six, those of the spire step-shaped or shouldered, but flattened somewhat obliquely next to the shoulder above, the outer volution rounded and moderately ventricose below the shoulder : suture distinct and angular.

*Bulletin of the U. S. Geological Survey, No. 51, p. 17.

"Surface marked with narrow but comparatively distant spiral ridges, which are crossed by very numerous, close-set and regularly arranged, acute, longitudinal, thread-like raised lines. On the dorsal portion of the last volution of the spire there are three of these spiral ridges, and upon that of the outer volution about seven. Test thin, its inner layer distinctly nacreous.

"The exact dimensions cannot be given, but an average specimen is estimated to have been eleven millimetres and a-half in length, and nine in maximum breadth, when perfect.

"North-west side of Hornby Island, W. Harvey, 1894: four or five crushed specimens.

"This interesting little shell is referred to the genus *Eunema*, mainly on the authority of Zittel,* who states that *Amberleya*, Morris and Lycett, and *Eucyclus*, Deslongchamps, are synonymous with it, and that it ranges in time from the 'Lower Silurian' into the Cretaceous."

Three additional examples of this species were obtained at Hornby Island, by Mr. Harvey, in 1895, but these throw no additional light on its characters.

Margarita ornatissima, Gabb. (Sp.)

Angaria ornatissima, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 121, pl. 20 fig. 78.

Margarita ornatissima, Whiteaves. 1879. This volume, pt. 2, p. 128.

" " White. 1889. Bull. U. S. Geol. Surv., No. 51, p. 45.

A few additional specimens of this shell were collected at the Sucia Islands, by Dr. Newcombe, in 1894 or 1896; and at Yorke's Farm, two miles and a quarter to two miles and a half up the Nanaimo River, by Mr. Harvey in 1901.

Solariella (radiatula? var.) occidentalis.

Plate 45, figs. 5, and 5 *a*.

Solariella radiatula (Forbes) Schmidt. 1873. Uber die Petref. der Kreide-form. von Sachalin, in Mem. l'Acad. Imper. des Sciences de St. Pétersbourg, Series VII, vol. XIX, p. 18, pl. 4, figs, 3, 4 and 5.

Shell essentially similar to *S. radiatula*, as described and figured by Dr. Schmidt in the memoir cited, but with the upper part of the later volutions, especially that of the outer one, much more distinctly flattened downward next to the suture; or, in other words, more step-shaped above.

*Handbuch der Palæontologie, vol. II, 1884, p. 189.

The Vancouver specimens may be thus described. Shell small, turbinate, about as high as broad, with a moderately elevated spire and a rather narrow but deep umbilicus. Volutions about six, those of the spire convex, the later ones slightly flattened downward next to the suture, above; the outer one ventricose, but distinctly flattened or even shallowly concave above, rather higher than the spire, as viewed dorsally, umbilicus occupying about one third of the diameter of the base, with a minutely angulated and crenulated margin; aperture apparently nearly circular, lip thin and simple.

Surface marked by numerous, close-set, flattened and obliquely transverse costæ, that are crossed by equally or still more minute, and close set spiral ridges.

An average specimen is six millimetres broad, and about as high as broad.

A few specimens of this shell were collected quite recently (in 1901) by the Rev. G. W. Taylor, at Brennan Creek, V.I., and by Mr. Harvey, on the Nanaimo River. These agree much better with Schmidt's than with Stoliczka's figures of *S. radiatula*. In the latter the volutions are represented as regularly rounded, and not at all flattened next to the suture. Stoliczka, also, says that *S. radiatula* is "composed of about seven or eight convex volutions," but in the Vancouver Island specimens there are apparently not more than six.

The specimen figured, though the most perfect one that has yet been obtained, is abnormally depressed. All the other specimens are more elevated, and show the flattening at the suture more distinctly.

Phaneta (?) decorata. (N. Sp.)

Plate 45, figs. 6, 6*a*, and 7.

Shell rather small, spiral, wider than high, gently convex and somewhat dome-shaped above, angular and carinate at the periphery, and somewhat flattened at the base below. Volutions two and a half or three, rapidly expanding and strongly embracing; spire short, low, obtuse, partially overlapped by the upper part of the outer volution, and not raised above its highest level; suture indistinct. Outer volution encircled by a narrow, entire and simple spiral keel or keel-like fold; aperture very large, occupying the greater part of the base, nearly circular, but with the continuity of the peristome apparently slightly interrupted by the encroachment of the preceding volution, though this feature is not well seen in either of the few specimens collected; outer lip simple.

On and above the peripheral keel of the outer volution the whole surface is finely cancellated by minutely tuberculated ridges, which are so arranged as to form regular, equidistant and parallel, obliquely transverse rows, as well as distinct spiral ones. Near the aperture, there are seventeen of these spiral rows of tubercles. Below the peripheral keel there is one spiral ridge and numerous, rather coarse, obliquely transverse growth lines but there are, apparently, no tubercles upon the base. In the largest specimen collected (figure 7) the outer volution, next to the suture above, is partially encircled with a narrow, erect, spiral fold or plication, crossed by oblique non-tuberculated ridges and striæ, as well as by the peripheral alation.

Roof of coal, Nanaimo mines, W. Harvey, 1901: three specimens, which are only provisionally and rather doubtfully referred to H. Adams' genus *Phaneta*. In many respects they agree very well with the generic and specific description, and with the figures, of *P. Everetti*, H. Adams, in the twelfth volume of Tryon's Manual of Conchology, but in *Phaneta* the suture is said to be distinct, the aperture is represented as channeled at the peripheral keel, and the upper surface is not minutely tuberculated. Moreover *P. Everetti*, the type and hitherto only known species of the genus, is known to be a fresh water shell, whereas the Nanaimo specimens are presumably marine, as they are found associated with such purely marine genera as *Crassatella*, *Pectunculus*, *Nucula* proper, *Acila*, *Leda*, *Cinulia*, *Trochactæon*, &c. The sculpture of their upper surface is very like that of some species of *Calliostoma* and *Turcicula*, but their lower surface, including the mouth, is more like that of such a typical *Stomatella* as *S. imbricata*. They may indicate a new generic type of Trochidæ or Stomatellidæ, for which the name *Euphaneta* might be appropriate.

Helcion giganteus? var. Vancouverensis.

Plate 51, fig. 1.

Cfr. *Helcion giganteus*, Schmidt. 1873. Ueb. die Petref. der Kreide-form. von Sachalin, p. 19, pl. 2, figs. 17, 18; pl. 3, figs. 1–10; and pl. 8, figs. 2–5.

Shell very large, patelliform, depressed conical, apex eccentric, placed very near to the anterior margin, but not quite marginal, aperture a little longer than wide, rounded subovate, or nearly circular but somewhat pointed behind.

Surface marked with concentric lines of growth, and low rounded radiating ribs or plications, that are faint and almost obsolete centrally, but fairly well defined around the outer margin.

The specimen described is about four inches in length, and very little less in breadth.

Nanaimo River, V.I., below the coal, W. Harvey, 1901 : one fine specimen which, however, has a considerable portion of its surface worn and partially eroded. It seems to differ from the typical *H. giganteus* only in the much more feeble development of its radial ribs.

As already stated, it is quite likely that the three fossils from the Comox River described provisionally on pages 364 and 365 as *Capulus corrugatus*, may prove to be very young specimens of this variety of *Helcion giganteus*.

Helcion tenuicostatus. (N. Sp.)

Plate 45, figs. 8 and 8*a*.

Shell small, depressed conical, not more than one-half as high as wide, apex apparently erect, obtuse, placed in advance of the midlength, and a little to one side, aperture broadly oval.

Surface widely but rather faintly undulated concentrically, and marked by very numerous, narrow, prominent, acute and slightly flexuous, radiating ribs.

Approximate dimensions of the specimen figured : length sixteen millimetres ; width or breadth, twelve mm. ; maximum height, six mm.

Extension mine, near Nanaimo, V.I., nine specimens ; and Texada Island, two or three specimens ; all collected by Mr. Harvey in 1901.

This finely ribbed little limpet seems to differ from the *Helcion granulatus* of Stanton,* from the Knoxville beds of California, in its proportionately greater height, and in the apparent absence of the "rather closely arranged, impressed concentric lines" said to be characteristic of that species.

Genus and species uncertain.

Plate 45, fig. 9.

Six well preserved but somewhat crushed and very imperfect specimens of the shell of a small gasteropod, that the writer has not been able to refer satisfactorily to any known genus, were collected from the roof of the coal at the Nanaimo mines by Mr. Harvey, in 1901, and are now in the Museum of the Survey. One of these has only a single volution preserved ; four, including the one figured, the outer volution and one or two of the preceding ones; and one, part of four volutions of the spire. Their sculpture consists of very numerous and close-set, fine striæ of growth, and a few irregulary disposed, and more or less minute spiral ridges.

* Bulletin of the U. S. Geological Survey, No. 133, p. 63, pl. xii, fig. 4.

In their shape and surface markings these specimens are apparently very similar to the subcarinate variety of *Campeloma productum*, White* (which seems to be congeneric with *Goniobasis Nebrascensis*), but they evidently have a much thinner test, and a much more lustrous and highly polished surface. They are also somewhat similar, both in shape and sculpture to the *Tylostoma bulimoides* of Stoliczka,† but in the Nanaimo specimens there are no indications of any inner fold-like varices.

Scaphopoda.

Dentalium Nanaimoense, Meek.

Dentalium Nanaimoensis, Meek. 1857. Trans. Albany Inst., vol. IV, p. 44.

Dentalium Koomooksense, Meek. 1876. Bull. Geol. and Geog. Surv. Terr., vol. II, p. 364, pl. 3, fig. 6.

Dentalium Nanaimoense, Whiteaves. 1879. This volume, pt. 2, pl. 133, pl. 16, figs. 9, 9 *a*, *b*.

The specimens of this species that were described and figured by Meek are from Nanaimo and Comox, as is clearly indicated by the two names cited in the foregoing synonymy. Similar specimens were obtained by Mr. Richardson, two miles and a half up the Nanaimo River, and at Denman Island, in 1872; at the Sucia Islands in 1874, and at Admiralty Island in 1875. Quite recently, in 1901, one specimen of *D. Nanaimoense* was collected at Brennan Creek, V. I., by the Rev. G. W. Taylor; and another two miles and a quarter to two miles and a half up the Nanaimo River, by Mr. Harvey.

Entalis Cooperi, Gabb.

Dentalium Cooperi, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 139, pl. 21, fig. 100.

Entalis Cooperi, Whiteaves. 1879. This volume, pt. 2, p. 134, pl. 16, figs. 10 and 10 *a*.

Additional specimens of *E. Cooperi* were collected at Hornby Island by Mr. Harvey in 1894.

Pelecypoda.

Martesia (?) parvula. (N. Sp.)

Plate 45, fig. 10.

Shell very small for the genus, moderately elongated, narrowly subovate and not quite twice as long as high. Anterior side short, abruptly

* As figured on Plate 26, figs. 24, 25 and 26, of his "Non Marine Mollusca of North America," published in 1883, by the U. S. Geological Survey.

† Cretaceous Gasteropoda of Southern India, pp. 42 and 448, pl. v, fig. 5.

rounded, but faintly subangular at the midheight in marginal outline, the foot opening of moderate size, and closed with a callous plate, or thin calcareous deposit; posterior side somewhat attenuate, longer than the anterior and more narrowly rounded at its termination exteriorly; ventral margin nearly straight at and behind the midlength; superior border sloping abruptly downward in front of the beaks, and much more gradually so behind them; beaks placed in advance of the midlength but not quite terminal: accessory valves, if any, unknown.

Surface marked with an obliquely transverse, narrow umbono-ventral groove that is bounded on each side by a row of minute punctures, and by concentric striations or sulci, that are coarser behind this groove than in front of it.

Interior of the valves unknown.

Dimensions of the specimen figured: length, ten millimetres and a quarter; maximum height, five mm. and three-quarters.

Extension mine, near Nanaimo, V.I., W. Harvey, 1901: the right valve figured, which is now in the Museum of the Survey.

This little shell is not nearly so attenuate behind nor so ventricose anteriorly as the Vancouver Island specimens of *Martesia clausa*, Gabb, that are described and figured in the second part of this volume.* It is by no means certain that the former is a true *Martesia*.

Cymbophora Ashburneri, Gabb.

1. Large ribbed variety.

Mactra Ashburneri, Gabb (pars). 1864. Geol. Surv. Calif., Palæont., vol. I, p. 153.
Cymbophora Ashburneri, Gabb (pars). 1869. Idem, vol. II, p. 181.
" " Whiteaves. 1879. This volume, pt. 2, p. 141, pl. 17, fig. 8.

Shell comparatively large; whole surface concentrically ribbed, the ribs separated by deep grooves, and both ribs and furrows minutely and concentrically striated.

Specimens of this form of *C. Ashburneri* were collected by Mr. James Richardson at Blunden Point, Vancouver Island, in 1871; at Hornby and Protection islands in 1873; and at the Sucia islands in 1874. Similar specimens have since been collected at the Sucia Islands by Dr. C. F. Newcombe, in 1894; at Brennan Creek, V.I., and at Protection Island by the Rev. G. W. Taylor, in 1901; also at Protection and Texada islands by Mr. Harvey, in 1901.

*On page 137, and Plate 17, figs. 2, 2 *a*, and 2 *b*.

2. Small, nearly smooth variety.

Mactra (Cymbophora?) Warrenana, Whiteaves. 1879. This volume, pt. 2, p. 142, pl. 17, fig. 9, and pl. 19, figs. 3 and 3 *a*; but perhaps not *Cymbophora Warrenana* of Meek and Hayden.

Shell comparatively small, concentric ribs nearly or altogether obsolete, the surface markings for the most part consisting of close-set concentric striæ, and from one to three distant groove-like constrictions, or periodic arrests of growth.

Specimens which the writer once thought to be possibly identical with the *Cymbophora Warrenana* of Meek and Hayden, but which can scarcely be satisfactorily distinguished from *C. Ashburneri*, were collected by Mr. Richardson at the Sucia Islands in 1874, and two miles and a half up the Nanaimo River, V.I., in 1875. Similar specimens have since been collected at the Sucia Islands by Dr. Newcombe (in 1894), and at Brennan Creek, V.I., by the Rev. G. W. Taylor (in 1901).

Anatina sulcatina? Shumard.

Anatina sulcatina? Shumard. 1861. Proc. Boston Nat. Hist. Soc., vol. VIII, p. 204.
Anatina sulcatina, Whiteaves. 1879. This volume, pt. 2, p. 139, pl. 17, figs 5 and 5 *a*.
Anatina sulcatina? Shumard. White. 1889. Bull. U. S. Geol. Surv., No. 51, p. 43, pl. VI, fig. 1.

Doctors C. A. White and T. W. Stanton are inclined to think that the Sucia Island specimens that have been referred to *A. sulcatina* are probably distinct therefrom, and it is of course quite possible that this may be the case, as Shumard never figured his species. An additional specimen of an *Anatina* that would seem to be at least very similar to *A. sulcatina*, but that it might be convenient to distinguish provisionally by the name *A. affinis*, was collected at the Sucia Islands by Dr. Newcombe in 1894; and a similar one at Brennan Creek, V. I., by the Rev. G. W. Taylor in 1901.

Anatina subcylindracea. (N. Sp.)

Plate 45, fig. 11.

Shell rather small, moderately convex, slightly compressed, very inequilateral, straight, elongated, a little more than twice as long as high, and subtruncate at both ends. Anterior side much shorter than the posterior; anterior end truncated almost vertically but somewhat obliquely above and rounded below; posterior end abruptly truncated and widely gaping; cardinal border long, horizontal and nearly straight, behind the beaks; ventral margin also straight for the greater part of its length and

parallel with the posterior part of the cardinal border; beaks small, incurved and placed in advance of the midlength.

Surface concentrically striated.

Hinge dentition and muscular impressions unknown.

Dimensions of the specimen figured: maximum length, 24·6 mm.; greatest height, 11.

Brennan Creek, V.I., Rev. G. W. Taylor: one specimen and a fragment of another, both of which have been kindly presented to the Museum of the Survey.

Thracia subtruncata, Meek.

Thracia(?) subtruncata, Meek. 1857. Trans. Albany Inst., vol. IV, p. 44.
" " Meek. 1876. Bull. Geol. and Geogr. Surv. Terr., vol. II, no 4, p. 363, pl. 2, figs. 4 and 4 *a*.
" " Whiteaves. 1879. This volume, pt. 2, p. 140, pl. 17, fig. 7.

Two specimens of this shell were collected at the Sucia Islands by Dr. Newcombe in 1894.

Pholadomya subelongata, Meek.

Pholadomya subelongata, Meek. 1857. Trans. Albany Inst., vol. IV, p. 41.
" " Meek. 1876. Bull. Geol. and Geogr. Surv. Terr., vol. II, no. 4, p. 362, pl. 2, figs. 1 and 1 *a*.
Pholadomya Royana, Whiteaves. 1879. This volume, pt. 2, p. 140. But probably not *P. Royana*, d'Orbigny, 1844, which Pictet makes a synonym of *P. nodulifera*, Munster, in Goldfuss.

Additional examples of this species have been collected at the Sucia Islands by Dr. Newcombe in 1894, and from the roof of the coal at the Nanaimo mines by Mr. Harvey in 1901.

Panopæa concentrica, Gabb. Var.

Cfr. *Panopæa concentrica*, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 148, pl. 22, fig. 119.
Homomya concentrica, Gabb. 1869. Idem, vol. II, pp. 179 and 236.

Texada Island, W. Harvey, October, 1901: two imperfect casts of the interior of both valves, with portions of the test preserved. The larger of these is fully four inches in length and the smaller nearly three and a half. These specimens seem to differ from the Californian types of *Panopæa* (or *Homomya*) *concentrica* in their longitudinally elliptic-subovate rather than subquadrate outline, in their broader, more obtuse and more nearly median umbones, and in their

shallowly concave superior border behind. Their test is comparatively thick and neither minutely granulated nor punctate.

Cuspidaria Suciensis. (N. Sp.)

Plate 46, fig. 2.

Shell rather small, moderately convex, somewhat compressed, nearly twice as long as high and very inequilateral. Anterior side rounded, longer and much broader than the posterior side, which is abruptly and somewhat concavely contracted both above and below; ventral margin strongly convex, most prominent at the midlength; superior border, straight and horizontal behind the beak, which is incurved, slightly recurved, and placed behind the midlength; posterior umbonal slope faintly angulated.

Surface concentrically striated; test very thin.

Hinge dentition and muscular impressions unknown.

Sucia Island, Dr. C. F. Newcombe, 1894: the specimen figured, which is a perfect cast of the interior of a right valve, with small portions of the test preserved.

Dimensions of the specimen: maximum length, not quite fourteen millimetres; greatest height, nine mm. and a half.

This little shell is provisionally referred to the genus *Cuspidaria*, on account of its cuspidate posterior extremity and extremely thin test.

Tellina occidentalis, Whiteaves.

Tellina (Peronæa) occidentalis, Whiteaves. 1879. This volume, pt. 2, p. 144, pl. 17, figs. 11 and 11 *a*; but not *Tellina occidentalis*, Morton, 1842, which is a *Lucina*; nor *Thracia (?) occidentalis*, Meek, 1857.

Tellina occidentalis, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 126.

"The specimens from Gabriola Island and the Nanaimo River, which the writer formerly supposed to be referable to *Thracia occidentalis*, Meek, prove to be distinct from that shell, which Mr. Stanton states has a pearly lustre and other characters of the Anatinidæ." (Op. cit., 1896.)

Tellina Nanaimoensis. (N. Sp.)

Plate 46, fig. 3.

Tellina (Peronæoderma) Mathewsoni, Whiteaves. 1879. This volume, pt. 2, p. 143; but probably not *Tellina Mathewsoni*, Gabb.

Shell strongly compressed, thin, the thickness through the closed valves being not much more than a third of their height, broadly sub-

elliptical, about one fourth longer than high and almost equilateral. Anterior and posterior sides about equal in length, their extremities narrowly rounded; ventral margin very slightly convex, almost straight in the middle; superior border sloping rather rapidly downward on both sides of the beaks, which are small, median, incurved and slightly recurved.

Surface marked with very numerous and closely arranged, minute and concentric raised lines of growth.

Hinge dentition and anterior muscular impression unknown; posterior muscular impression narrowly elongate, lanceolate subovate, widest below and acutely pointed above.

The specimen figured is not sufficiently perfect to admit of very accurate measurements being given, but the figure is of the natural size.

Nanaimo River, V.I., J. Richardson, 1875: an imperfect but well preserved cast of the interior of both valves, with part of the test preserved upon each.

Judging by the figure on Plate 23 of the first volume of the Palæontology of California, the true *T. Mathewsoni* is more elongate, more pointed at both ends, and consequently more nearly triangular in outline.

Asaphis multicostata, Gabb.

Asaphis multicostata, Gabb. 1869. Geol. Surv. Calif., Palæont., vol. I, pp. 181 and 236, pl. 29, fig. 70.

Linearia Suciensis, Whiteaves. 1879. This volume, pt. 2, p. 146, pl. 17, fig. 12.

Sucia Islands, J. Richardson, 1875: the type of *L. Suciensis*. Nanaimo mines, V. I., W. Harvey, 1901: a small left valve.

In a report upon the Cretaceous fossils from Spanish Gulch, Oregon, published in 1901, in Professor J. C. Merriam's "Contribution to the Geology of the John Day Basin," Dr. Stanton writes that *L. Suciensis* is "similar in form and sculpture" to *Asaphis multicostata*, "and may be based upon the same species." And, still more recently, a direct comparison of *L. Suciensis* with two authentic Oregon specimens of *A. multicostata*, kindly forwarded by Dr. Stanton, has induced the writer to come to the same conclusion.

Meretrix nitida, Gabb.

Cytherea Leonensis, Etheridge. 1861. In Hector's paper in the Quart. Journ. Geol. Soc. Lond., vol. XVII, p. 432; but not *C. Leonensis*, Conrad, 1859.

Cytherea Conensis (err. typ. for *Leonensis*) Etheridge. 1863. No. 42 of the list of specimens on p. 243 of Capt. Palliser's Official Report.

Venus (Mercenaria?) varians, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 161, pl. 23, figs. 140, 140 *a*, and 141.

Meretrix nitida, Gabb. 1864. Idem, p. 165, pl. 23, fig. 147.

Caryatis nitida, Gabb. 1869. Ibid., vol. II, pp. 186 and 240.

Chione varians, Gabb. 1869. Ibid., p. 239.

Cytherea (Caryatis) plana, Whiteaves. 1879. This volume, pt. 2, p. 149, pl. 17, figs. 14, 14 *a*, and 14 *b*; but probably not "*Venus planus*," Sowerby, nor *Aphrodina Tippana*, Conrad.

Cytherea nitida, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, pp. 114 and 124.

Meretrix varians, Stanton. 1901. Univ. Calif., Bull. Dept. Geol., vol. II, pp. 281 and 283.

Departure Bay, Nanaimo (below the lignite) Dr. Hector, 1860, collected by Mr. Mackay : ten rough casts of the interior of single valves of this species, each labelled No. 42, *Cytherea Leonensis*.

Entrance to Departure Bay, V. I., one imperfect valve ; and Nanaimo River, V. I., two miles and a quarter up, two specimens ; J. Richardson, 1872. Sucia Islands, J. Richardson, 1875 : several specimens.

Texada Island, W. Harvey, 1901 : several fine specimens.

The latest name that Dr. Stanton gives to this species is *Meretrix varians*, but it would appear to be preoccupied. The names *Meretrix* and *Cytherea* were given by Lamarck at different times to the same genus, and Hanley, in 1844, described a recent marine shell, under the name *Cytherea varians*, in the proceedings of the Linnæan Society, and figured it on Plate 15, figure 33, of his Illustrated and Descriptive Catalogue of Recent Bivalve Shells, an appendix to Wood's Index Testaceologicus. For these references the writer is indebted to Dr. Dall, who writes that "the name *Cytherea* must give way to *Meretrix*, if for no other reason than because *Cytherea* was used by Fabricius for Diptera a year before Lamarck used it for a mollusk. It is true Bolten used it before either of them, but Bolten's *Cytherea* is a totally distinct thing from Lamarck's."

Meretrix arata, Gabb.

Meretrix arata, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 166, pl. 30, fig. 250; and (1869) vol. II, p. 240.

Cytherea (Callista) laciniata, Whiteaves. 1879. This volume, pt. 2, p. 148, pl. 17, figs. 13 and 13 *a*, and plate 19, figs. 4 and 4 *a* ; but probably not *Cytherea (Callista) laciniata*, Stoliczka, 1871.

Cytherea arata, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 125.

"The specimens referred to *Cytherea* (*Callista*) *laciniata*, Stoliczka," in the second part of this volume have "been found to be exactly similar to a specimen from the Chico group of Tehama county, California, which

Dr. Stanton has identified with *Meretrix arata*, Gabb, and kindly loaned to the writer. The original description of the sculpture of *M. arata* is rather misleading. According to Mr. Gabb, its surface is 'ornamented by regular, concentric, acute impressed lines,' whereas, in the writer's judgment, it would be much more correct to say by small, concentric, rounded ribs, with very narrow furrows between them" (1896, op. cit. supra.)

A few additional specimens of this species were collected at the Sucia Islands by Dr. Newcombe in 1894 and 1896. A small but perfect left valve, some sixteen millimetres long, collected at Texada Island, by Mr. Harvey, in 1901, seems to be intermediate in its character between *M. nitida* and *M. arata*. On and immediately around the umbo the surface of this specimen is minutely and regularly ribbed concentrically, but, below, fully two-thirds of the surface are only striated in the same direction.

Cyprimeria lens, Whiteaves.

Cyprimeria lens, Whiteaves. 1879. This volume, pt. 2, p. 152, pl. 17, figs. 15 and 15 *a*; but not *Meretrix lens*, Gabb, 1864, which is probably not a *Cyprimeria*.
" " White. 1889. Bull. U. S. Geological Surv., No. 51, p. 42.
" " Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 125.

"Shell compressed convex, moderately inflated, ovately subcircular in marginal outline, and nearly as high as long; posterior side a little longer, and in some specimens rather more narrowly rounded than the anterior; basal margin broadly convex; superior border descending rapidly and obliquely in front of the beaks, gently convex and slightly prominent immediately behind them, thence curving gradually downward to the posterior end, beaks placed a little in advance of the midlength, small, depressed, appressed and curved forward. No definite nor distinctly margined lunule, and apparently no well defined escutcheon.

"Test rather thick, its surface polished and marked with numerous very fine and closely disposed concentric striæ, also with four or five distant and coarser linear concentric grooves or periodic arrests of growth.

"Hinge with two cardinal teeth and one lateral tooth in the left valve. The two cardinal teeth are transverse and divergent, the anterior one being thick and excavated in the middle, but not bifid. The lateral tooth, which is thin and feebly developed, is partially separated from the cardinal fulcrum by a narrow shallow groove. Anterior muscular impression large and subovate; posterior muscular scar, pallial line and hinge dentition of the right valve unknown.

"North-west side of Hornby Island, J. Richardson, 1875, one left valve. Sucia Islands, J. Richardson, 1874: three imperfect right valves and one left valve, the latter showing the hinge dentition of that valve; and Dr. C. F. Newcombe, 1894, one large and perfect left valve.

"These are most probably not identical with the *Meretrix lens* of Gabb, as the writer once supposed they were. The specimen from Hornby Island is a little more pointed posteriorly than those from the Sucia Islands, but this feature is rather exaggerated in the unsatisfactory figure of this specimen, on Plate 17" of the second part of this volume. "The specimens from the Sucia Islands have more the general contour of a *Dosinia* than of a *Meretrix* (or *Cytherea*)" . . . . . "and their hinge dentition is that of *Cyprimeria*. In the original description of *Meretrix lens* nothing is said, and nothing appears to be known, about the hinge dentition or other characters of the interior of the shell, but there are at present no valid reasons known to the writer for doubting the correctness of its reference to the genus *Meretrix* or *Cytherea*.

"Mr. Stanton, who has kindly compared the Sucia Island specimens with Meek's types of *Cyprimeria ? tenuis*, from Vancouver and Newcastle islands, thinks that the latter species (whose internal characters are still unknown) is much more compressed and has a different outline" (1896, op. cit. supra).

Additional specimens of *C. lens* were collected by Dr. Newcombe, in 1896, at the Sucia Islands; by Mr. Harvey, in 1901, ten to twelve miles up the Nanaimo River, V.I., and on Texada Island; and by Mr. T. Bryant, in 1901, six or seven miles north-west of Wellington, V.I.

Dosinia inflata, Gabb.

Dosinia inflata, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 168, pl. 23, fig. 149.

Sucia Islands, Dr. C. F. Newcombe, 1896: one remarkably well preserved but slightly imperfect specimen, that corresponds perfectly with Gabb's description of *D. inflata*. In this genus it is almost impossible to identify species by descriptions and figures, but Mr. Frank M. Anderson has kindly compared this Sucia Island specimen with the type of *D. inflata* in the Geological Museum of the University of California, at Berkeley, and thinks that it agrees very well therewith.

Cyprina Denmanensis. (N. Sp.)

Shell large, compressed convex, apparently ovately subtriangular in marginal outline, and about one-sixth longer than high. Superior border

sloping somewhat concavely and obliquely downward in front of the beaks, and rather convexly as well as obliquely behind them; ventral margin very slightly convex, nearly straight in the middle; umbo and beak nearly median; posterior side not much longer than the anterior.

Surface concentrically and rather coarsely striated.

Hinge dentition and muscular impressions unknown.

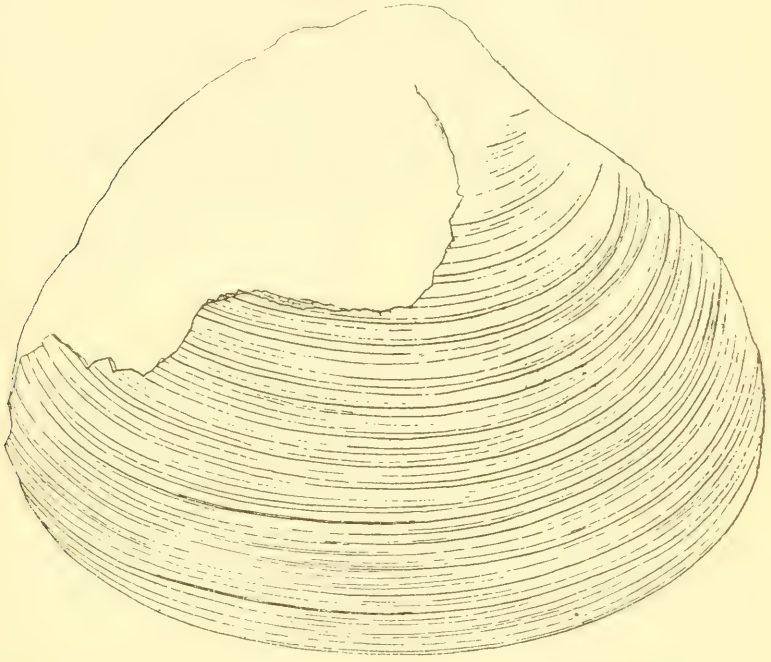


FIG. 25.—*Cyprina Denmanensis.* Outline of the only specimen collected, about five sixths of the natural size.

West side of Denman Island, Dr. C. F. Newcombe, 1896: the large right valve figured, which, unfortunately, has the umbo and lateral margins considerably eroded. The specimen, however, seems to indicate a species of *Cyprina* that differs alike from *C. occidentalis* of the Cretaceous rocks of the Queen Charlotte Islands, from *C. Dalli*, White, of the Cretaceous rocks of Alaska, and from the *C. ovata*, var. *alta*, of the Pierre-Fox Hills or Montana formation of Assiniboia and Alberta, in its much larger size, more nearly median beaks, and much straighter ventral margin.

Cyprina (?) anthracicola. (N. Sp.)

Shell of medium size for the genus, presumably compressed convex normally, though all the specimens that the writer has seen are crushed flat. In this condition they are rounded subovate and very little longer than high. The anterior side is short and rounded; the posterior side a little longer, its extremity subtruncate abruptly and somewhat obliquely above, and obtusely subangular below. The ventral margin is broadly rounded; the superior border slopes abruptly downward in front of the beaks, and much more gradually so behind them; the beaks are compressed, slightly depressed, and placed considerably in advance of the mid-length of the cardinal margin.

Fig. 26.—*Cyprina (?) anthracicola.* Side view of the most perfect but not the largest specimen collected, of the natural size and shewing the right valve. It is crushed quite flat.

Surface marked with very numerous and closely disposed, fine concentric ridges, or raised lines of growth, and a few much coarser and more distant concentric sulcations. Test thick.

Hinge dentition and muscular impressions unknown.

The largest specimen that the writer has seen is sixty-five millimetres long and sixty millimetres high.

Roof of coal, No. 1 shaft, Nanaimo: two nearly perfect, but crushed and flattened specimens, and four very imperfect ones, all collected in 1901, the specimen figured, by the Rev. G. W. Taylor, and the others by Mr. Harvey.

It is just possible that these specimens may prove to be only immature examples of *C. Denmanensis*, but their beaks are by no means submedian and their marginal outline seems to be more rounded than triangular.

Protocardia scitula, Meek.

Cardium scitulum, Meek. 1857. Trans. Albany Inst., vol. IV, p. 40.

Protocardia scitula, Meek. 1876. Bull. Geol. and Geogr. Surv. Terr., vol. II, no. 4, p. 360, pl. 3, figs. 4 and 4 *a*.

Protocardium scitulum, Whiteaves. 1879. This volume, pt. 2, p. 155.

Several specimens, that are clearly referable to this diminutive species, were collected at Yorke's farm, two and a quarter to two and a half miles up the Nanaimo River, V.I., by Mr. Harvey in 1901.

Thyasira cretacea, Whiteaves.

Conchocele cretacea, Whiteaves. 1874. Geol. Surv. Canada, Rep. Progr. for 1873-74, p. 266, pl. of fossils, figs. 2 and 2 *a*; and (1879) this volume, pt. 2, p. 156.

On page 784 of his "Synopsis of the Lucinaceæ and of the American species," published in 1901, in volume xxiii of the Proceedings of the U. S. National Museum, Dr. Dall places *Conchocele*, Gabb, 1866; *Cryptodon*, Turton, 1822; and *Axinus*, J. Sowerby, 1821; among the synonyms of *Thyasira*, Leach, 1818. The proper name for this species, therefore, would seem to be *Thyasira cretacea*, and the writer has seen no other specimens of it than those collected below Dodd Narrows. V.I., by Mr. Richardson in 1873.

Clisocolus dubius, Gabb.

Loripes dubius, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. i, p. 177, pl. 24, figs 170 and 171.

Clisocolus dubius, Gabb. 1869. Idem, vol. ii, p. 189, pl. 30, fig. 7.

Lucina Richardsonii, Whiteaves. 1874. Rep. Progr. of this Survey for 1873-74, p. 266, pl. of fossils, fig. 1.

Thetiopsis circularis, Whiteaves. 1879. This volume, pt. 2, p. 153.

Clisocolus dubius, White. 1889. Bull. U. S. Geol. Surv., No. 51, p. 41, pl. 6, figs. 5-7.

" " Whiteaves. 1895. Trans. Royal Soc. Canada, Second Series, vol. i, sect. iv, p. 123.

As stated in the publication last cited, "the specimens from Vancouver, Hornby and the Sucia Islands, which the writer first described as *Lucina Richardsonii*, and afterwards referred to the *Thetis circularis* of Meek and Hayden, the type of Meek's suggested genus *Thetiopsis*, are obviously identical with the *Clisocolus dubius* as since figured by Dr. C. A. White, and with specimens from the Chico group of Shasta county, California, labelled *C. dubius*, and kindly loaned by Mr. Stanton. "It still, however, appears to the writer that the specimens collected by Mr. Richardson are much more like the *Thetis circularis*, as figured by Meek and by Whitfield, than they are to Gabb's illustrations of *C. dubius*."

Specimens of this species were collected at the Sucia Islands by Dr. Newcombe in 1894; and at Departure Bay, V. I., by Mr. Harvey in 1901.

Clisocolus cordatus, Whiteaves.

Clisocolus cordatus, Whiteaves. 1879. This volume, pt. 2, p. 157, pl. 18, figs. 3, 3, *a-b*; but probably not *Cyprina cordata* of Meek and Hayden (1857) nor *Clisocolus dubius*, Gabb.

" " White. 1889. Bull. U.S. Geol. Surv., No. 51, p. 41, pl. 6, figs. 8 and 9.

" " Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 124.

"The identification of the Sucia Islands specimens collected by Mr. Richardson with the species from the Fox Hills group of Dakota, which was first described by Meek and Hayden as *Cyprina cordata*, and subsequently by Meek as *Sphæriola cordata*, has not proved satisfactory, and they seem to be quite distinct from Gabb's *Clisocolus dubius*" (1896. op. cit. supra.)

A few specimens, which seem to be referable to *C. cordatus*, were collected in 1901 at Brennan Creek, V.I., by the Rev. G. W. Taylor; and at Departure Bay, V.I., by Mr. Harvey.

Crassatella Conradiana, Gabb. (Sp.)

Astarte Conradiana, Gabb. 1864. Geol. Surv., Calif., Palæont., vol. I, p. 178, pl. 24, fig. 161.

" " Whiteaves. 1879. This volume, pt. 2, p. 160, pl. 18, figs. 5 and 5 *a*.

Specimens of this species were collected at the Sucia Islands by Dr. Newcombe in 1894 or 1896, and at Texada Island by Mr. Harvey in 1901.

Crassatella Conradiana, var. tuscana.

Astarte Tuscana, Gabb. 1864. Geol. Surv., Calif., Palæont., vol. I, p. 179, pl. 30, fig. 257.

Astarte cardinioides, Whiteaves. 1874. Rep. Progr. of this Survey for 1873-74, p. 267, pl. of fossils, fig. 3.

Astarte Vancouverensis, Whiteaves. 1874. Idem., p. 267, pl. of fossils, fig. 4.

Astarte Conradiana, var. *Tuscana*, Whiteaves. 1879. This volume, pt. 2, p. 160, pl. 18, fig. 6.

Crassatella Tuscana, White. 1889. Bull. U. S. Geol. Surv., No. 51, p. 39.

Mr. Harvey has collected numerous specimens, which, in the writer's judgment, are referable to this elongated variety of *C. Conradiana*, at North West Bay, Vancouver Island, in 1897; from the roof of the coal at the Nanaimo mines, V.I., and at Texada Island, in 1901.

Opis Vancouverensis, Whiteaves.

Opis Vancouverensis, Whiteaves. 1879. This volume, pt. 2, p. 158, pl. 18, figs. 4 and 4 *a*.

This species was based upon a slightly imperfect right valve, collected on the south-west side of Denman Island by Mr. Richardson in 1871. The only other specimen of it that the writer has seen is a still more imperfect but characteristic right valve, collected at Brennan Creek, near Wellington, V.I., by the Rev. G. W. Taylor, in 1901.

Unio Nanaimoensis, Whiteaves.

Unio Nanaimoensis, Whiteaves. 1901. Ottawa Naturalist, vol. XIV, pp. 177-79, figs. 1 and 1*a*.

"In the second volume of the Palæontology of California, published in 1869, Mr. W. M. Gabb described and figured a Cretaceous species of *Unio*, which he called *U. Hubbardi*. This species was based upon a single specimen, which is said to be "from the Nanaimo Coal Mine, Vancouver Island," and to have been "kindly loaned" to Mr. Gabb by Mr. Samuel Hubbard. It has long seemed to the writer that the evidence for this locality is very unsatisfactory, and that there are two strong reasons for supposing that some mistake has been made in regard to it. The first of these reasons is that no similar specimens have since been found in the Cretaceous rocks at Nanaimo, or any other locality in Vancouver, or any of the immediately adjacent islands, by members of the staff of the Geological Survey of Canada, or by local collectors. The second is that numerous very typical specimens of *U. Hubbardi* were collected at the Cowgitz coal mine, on Graham Island (one of the Queen Charlotte Islands) by Mr. James Richardson in 1872, and by Dr. G. M. Dawson in 1878.

"No other land or fresh water shells have yet been recorded as occurring in the Cretaceous rocks of the Nanaimo, Comox, or Cowitchan coal fields. But in March, 1894, a nearly perfect but somewhat crushed and slightly distorted bivalve shell was found by Mr. W. Haggart, in shale at the top of No. 6 Pit, Wellington Colliery, Nanaimo. This specimen is now the property of the Provincial Museum, Victoria, B.C., and has been forwarded to the writer by Dr. C. F. Newcombe, of that city, for examination and comparison.

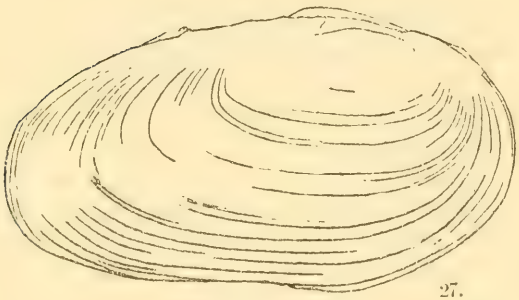
"Judging by its external form and surface markings, this fossil seems to be a specimen of a previously undescribed species of *Unio*, that is quite distinct from *U. Hubbardi* and from any of the Unionidæ of the Cretaceous or Laramie rocks of North America.

"The species may now be provisionally named and characterized as follows :—

UNIO NANAIMOENSIS (Sp. nov.)"

"Shell compressed-convex, ovately subelliptical, much longer than high, higher than broad, and very inequilateral. Anterior end short, rounded; posterior end much longer than the anterior, its extremity obliquely subtruncate above, produced and somewhat narrowly rounded below; beaks placed in advance of the midlength; posterior umbonal slopes not at all angulated.

27a.



27.

"Surface marked only with numerous concentric lines of growth. Hinge dentition, muscular impressions, and pallial line unknown.

FIG. 27.—*Unio Nanaimoensis.*—Side view of the only specimen known, in outline.

FIG. 27*a*.—Dorsal view of the same, also in outline, to shew the proportionate convexity of the closed valves.

Both the figures are of the natural size.

"Approximate dimensions of the specimen figured:—Maximum length, sixty-eight millimetres; greatest height, thirty-seven millimetres; maximum breadth or thickness, twenty-four millimetres.

"The slight distortion and somewhat slickensided movement to which the specimen has been subjected has so displaced the normal position of the valves that the marginal outline is not as distinctly defined as might be desired, and the beaks are no longer quite opposite.

"As compared with *U. Nanaimoensis*, *U. Hubbardi* is a much more convex shell, with distinctly angular or subangular posterior umbonal slopes, and it is much more attenuate posteriorly" (op. cit. supra.).

Trigonia Evansana, Meek.

Trigonia Evansana, Meek. 1857. Trans. Albany Inst., vol. iv, p. 42.

Trigonia Emoryi, Etheridge. 1861. In Hector's paper "On the Geology of the Country between Lake Superior and the Pacific Ocean," Quart. Journ. Geol. Soc. Lond., vol. xvii, p. 432; but not *T. Emoryi*, Conrad, 1857.

" " Etheridge. 1863. No. 40 of the list of specimens on p. 243 of Capt. Palliser's Official Report on his Explorations in British America in 1857-60.

Trigonia Evansii, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. i, p. 189, pl. 25, fig. 17.

Trigonia Evansi, Meek. 1876. Bull. U. S. Geol. and Geogr. Surv. Terr, vol. ii, No. 4, p. 359, pl. 2, figs. 7, 7*a* and 7*b*.

Trigonia Evansana, Whiteaves. 1879. This volume, pt. 2, p. 161; and (1896) Trans. Royal Soc. Canada for 1895, Second Series, sect. iv, p. 114.

In 1876, in the second volume of the Bulletin of the United States Geological and Geographical Survey of the Territories, Mr. Meek pointed out that his *Trigonia Evansana* is "almost certainly the same shell that was referred by Mr. Etheridge, among Mr. Hector's collections from Nanaimo, to *T. Emoryi* Conrad (pl. iii, figs. 2 *a*, *b*, *c*, United States and Mexico Boundary Survey Report.)" "It is, however," he says, "certainly very distinct from that species, not only in form and in its decidedly less crenate costæ, but more particularly in having a smooth, longitudinally sulcate, depressed ridge on each side of its escutcheon, not crossed by the costæ. Its costæ are likewise less numerous and more prominent."

In 1894, the Geological Society of London, through its president, Dr. Henry Woodward, kindly lent to the writer for study, all the Cretaceous fossils obtained during Captain Palliser's explorations, that were deposited at Burlington House. These form the subject of a paper published in 1896, in the first volume of the second series of the Transactions of the Royal Society of Canada. Among them were "ten specimens, mostly mere casts of the interior of single valves, each labelled 'No. 40, *Trigonia Emoryi*, Conrad; below the lignite, Departure Bay, Nanaimo, Dr. Hector, 1860; collected by Mr. Mackay." These, as was expected, are clearly referable to *T. Evansana*.

Meek's types of *T. Evansana* are both from Nanaimo, V.I., where they were probably collected by Mr. T. J. Turner, of the U.S. Navy, in 1856. On Vancouver Island, specimens of the same species were collected at North West Bay by Mr. Richardson in 1873, and by Mr. Harvey in 1897; at Departure Bay, by Mr. Harvey in 1901; and at Brennan Creek, near Wellington, by the Rev. G. W. Taylor in 1901. At the Sucia Islands similar specimens were collected by Mr. Richardson in 1874 and by Dr. Newcombe in 1894.

Nucula Hornbyensis, Whiteaves.

Plate 46, fig. 4.

Nucula Hornbyensis, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 122, pl. 3, fig. 2.

Original description and remarks.—"Shell of medium size for the genus, compressed convex, subelliptical in marginal outline, rather oblique and very inequilateral. Anterior or longer side obliquely subtruncated at its extremity above and rather narrowly rounded below; posterior or shorter side very regularly but narrowly rounded at the end; ventral margin broadly rounded, but rather more convex posteriorly than anteriorly; superior border nearly straight but slightly descending in front of the beaks, and sloping obliquely and much more rapidly downward behind them; beaks small, incurved and recurved, projecting very little above the highest level of the superior border, placed behind the mid-length, and in one specimen almost terminal.

"Surface almost smooth, marked only by a few faint concentric striæ of growth; test thin.

"Dimensions of the largest specimen known to the writer: length, eleven millimetres; height, eight millimetres. The specimen figured is not quite six millimetres in length.

"North-west side of Hornby Island, in the 'Middle Shales or Division D' of Mr. Richardson's Comox Section, W. Harvey, 1894: one right valve, one left valve, and a somewhat crushed specimen with both valves, each with the test preserved.

"These specimens may represent a variety of *Nucula solitaria*, but if Mr. Gabb's figure of that species is correct, it must have a very different marginal outline. His illustration represents a much more triangular shell than that of *N. Hornbyensis*, with a more prominent beak, and more pointed at both ends.

"*Nucula Traskana*, Meek, from the Cretaceous rocks of Vancouver Island, was described from a single worn cast of the interior of the shell, which has never been figured and has since been lost. Mr. Meek states that the specimen was 'probably provided with a distinct lunule,' and that 'the species will probably be recognized by its ventricose trigonal ovate form and nearly central beaks.' This description is quite inapplicable to the specimens from Hornby Island, in which the lunule and escutcheon are both obsolete."

Since this description was written, two other specimens of *N. Hornbyensis*, which are now in the Museum of the Survey, were collected at Hornby Island by Mr. Harvey in 1895. The larger of these, which is

apparently an adult shell, is about twelve millimetres in length by ten and a half mm. in height. As will be seen by the figure on Plate 46, its marginal outline is rounded subtrigonal and very different to that of the very young and somewhat elongate specimen that was previously figured. As compared with Meek's description of *N. Traskana*, its valves are compressed rather than ventricose, and its beak is by no means central.

A left valve of a *Nucula*, from the roof of the coal at the Nanaimo mines, collected by Mr. Harvey in 1901 and now in the Museum of the Survey, has a somewhat similar outline to the adult *N. Hornbyense*. But the former, which is fifteen millimetres long and a little over twelve high, is marked with very numerous and densely crowded, but very regularly disposed concentric raised lines or minute costulæ.

Dr. Stanton, who has kindly examined all these specimens, thinks that they are quite distinct from his *Nucula Gabbi*, "from the upper part of the Knoxville beds about three miles south of Lowerys, Tehama County,"* California.

Nucula Richardsoni.

Nucula pectinata, Whiteaves. 1879. This volume, pt. 2, p. 161, pl. 18, fig. 8; but not *Nucula pectinata*, J. Sowerby, 1818.

Nucula Richardsoni, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 122.

"Shell similar to *N. pectinata*, but less inequilateral and much shorter in proportion to its height, the beaks being more nearly central, the posterior side longer and more obliquely truncated, the anterior shorter and more broadly rounded at its outer termination.

"The slightly distorted valve from the lower part of the Trent River, Vancouver Island, which was referred with doubt to the *N. pectinata* of Sowerby by the present writer in 1879, appears to be sufficiently distinct from that species to warrant the new specific name now proposed for it, in memory of its discoverer" (1896, op. cit. supra.).

Nucula (Acila) truncata, Gabb.

Nucula truncata, Gabb. 1864. Geol. Sur. Calif., Palæont., vol. I, p. 198, pl. 26, figs. 184 and 184 *a*, *b*.

Nucula (*Acila*) *truncata*, Gabb. 1869. Idem, vol. II, p. 197.

" " " Whiteaves. 1879. This volume, pt. 2, p. 162.

On Vancouver Island, specimens of this species, as determined by the writer, were collected in 1901, from the roof of the coal at the New Van-

*Bulletin of the U.S. Geographical Survey, No. 133, p. 52.

couver Coal Co.'s mine, Nanaimo, and from ten to twelve miles up the Nanaimo River, by Mr. Harvey ; also at Brennan Creek, near Wellington, by the Rev. G. W. Taylor. Similar specimens had previously been collected at Hornby Island by Mr. Harvey in 1894, and at the Sucia Islands by Dr. Newcombe in 1894 or 1896.

In the first volume of the American Journal of Conchology, published in 1865, Mr. Conrad says of *N. truncata* that "two species are evidently confounded under this name. Mr. Gabb should" (he says) "have figured a specimen from each division, as he has done in *Amauropsis alveata*."

Much more recently, in 1898, Dr. Dall says that "an examination of undoubted Cretaceous specimens of *N. truncata* shows that the species differs from the Tertiary forms by its more impressed escutcheon, its finer and more delicate divaricate sculpture, and its more prominent close set regular and even concentric sculpture. Those I have seen are also smaller."*

In a letter received in March, 1902, Dr. Stanton writes that he "doubts whether the Tejon specimens are different from the Chico ones," but that in any event the name *N. truncata* should be applied to the Chico form, because the type specimens are from Chico localities."

Yoldia diminutiva. (N. Sp.)

Plate 47, fig. 2.

Shell very small, inequilateral, moderately convex, slightly produced and narrowly rounded in front, abruptly pointed and a little longer behind ; length nearly twice the maximum height ; beaks small, placed a little in advance of the midlength.

Surface apparently concentrically striated.

Length, 4·7 mm. ; greatest height, 2·9 mm.

Roof of coal, New Vancouver Coal Co's mine, Nanaimo, W. Harvey, 1901 : a cast of the interior of a left valve with a small portion of the test preserved. This little shell differs chiefly from the *Leda translucida*, of the Californian Tertiary, as described and figured by Gabb, in its very diminutive size, the figured specimen of *L. translucida* being represented as 12 mm. long. The genus *Leda*, however, is now restricted to shells with a "long tapered bicarinate rostrum," and *Y. diminutiva* is obviously congeneric with the *Yoldia microdonta* and *Y. ventricosa* of Meek, from

* Transactions of the Wagner Free Institute of Science, Philadelphia, vol. III, pt. iv, p. 573.

the Upper Missouri Cretaceous,* though all three seem to the writer to be more probably referable to *Yoldiella* or *Portlandia.*

Pectunculus Veatchii, Gabb. (Sp.)

Plate 47, figs 3 and 4.

Axinæa Veatchii, Gabb. 1864. Geol. Surv. Calif. Palæont., vol. I, p. 197, pl. 25, figs. 183 and 183 *a*.
" " Whiteaves. 1879. This volume, pt. 2, p. 162.
Pectunculus Veatchii, Stanton. 1896. U. S. Geol. Survey, 17th Annual Rep., pt. 1, pp. 1029 and 1039.

This is one of the commonest lamellibranchiate bivalves of the Vancouver Cretaceous. The writer has examined and studied specimens of it from the following localities, the collector's name and date at which the collections were made being added in parentheses. Vancouver Island: at Blunden Point and the entrance to Departure Bay (J. Richardson, 1872); at North West Bay (J. Richardson, 1872, and W. Harvey, 1897); from the roof of the coal at the Nanaimo mines, and ten to twelve miles up the Nanaimo River (W. Harvey, 1901); and at Brennan Creek, near Wellington (Rev. G. W. Taylor, 1901). Hornby Island (J. Richardson, 1871); Sucia Islands (J. Richardson, 1874, and Dr. Newcombe, 1894); and Texada Island (W. Harvey, 1901). All the specimens of this shell that were collected by Mr. Richardson were referred to *Axinæa Veatchii*, Gabb, by the writer, on page 162 of the second part of this volume. On the other hand, Dr. C. A. White, in 1889, identifies specimens from Sucia Island with *Axinæa sagittata*, Gabb, though with a query, as he (Dr. White) states that "none of them show the peculiar sagittate markings which suggested the name."†

The outer surface of the specimens from Texada Island is remarkably well preserved, and the finest surface markings are well shewn. These latter, when viewed with a lens, to the writer's surprise were seen to consist of a close, regular and very minute cancellation or network, consisting of densely crowded minute radiating raised lines, or low ridges with impressed lines between them, which are crossed by equally numerous, close set and minute, concentric raised lines, as represented by figure 4 on Plate 47. On a re-examination of the specimens collected long ago by Mr. Richardson, it was found that in all of those from Vancouver Island the surface is much worn and the finer markings obliterated, but that in the small specimens from the Sucia Islands the minute details of sculpture are well preserved.

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* See Report U. S. Geological Survey of the Territories, vol. IX, pp. 109 and 112, and Plates 2 and 15.

†Bulletin of the United States Geological Survey, No. 51, p. 39.

In April last (1902) the writer sent one of the Texada specimens to Dr. Stanton, with a letter asking if any of the California examples of *P. Veatchii* in the U. S. National Museum showed the same kind of minute surface markings. In reply to this communication Dr. Stanton wrote, that "on examining our collection of *Pectunculus Veatchii*, for comparison with your specimen, I was surprised to find that almost all of our specimens have the surface sufficiently weathered to have removed the finer radiating sculpture, if they ever possessed it. A few were found, however, such as the two I am sending in the same package with yours, which retain traces of striæ that I think are comparable with those on the Texada Island shell." Both of the specimens kindly forwarded for comparison by Dr. Stanton, one from Butte Co., and the other from Pences Ranche, California, shew traces of the minute cancellation seen on Texada Island specimens. It would appear, therefore, that the *Pectunculus* from the Vancouver Cretaceous is correctly referred to *P. Veatchii*, but that exceptionally well preserved specimens of that species are marked by a minute sculpture that has not previously been described.

Dr. Dall recently * adopts the name *Glycimeris* (DaCosta, 1778) for this genus, and regards *Axinæa*, Poli (1791 and 1795) and *Pectunculus*, Lamarck (1799) as mere synonyms thereof. Still, the latter name has been in use for so many years that it seems a pity to reject it, though the laws of priority may require the change.

Arca Vancouverensis, Meek.

Arca Vancouverensis, Meek. 1857. Trans. Albany Inst., vol. IV, p. 40.
Grammatodon (?) Vancouverensis, Meek. 1876. Bull. Geol. and Geogr. Surv. Terr., vol. II, no. 4, p. 356, pl. 3, figs. 5 and 5 *a*.
Nemodon Vancouverensis, Whiteaves. 1879. This volume, pt. 2, p. 163.

The type of *Arca Vancouverensis* was collected at Nanaimo, apparently by Mr. T. J. Turner, of the U. S. Navy, in 1856. Its dimensions are stated to be: length, ·74 inch; height, ·44 inch; and breadth, ·40 inch. "This species," Meek says, "will be readily distinguished by its vertically truncated posterior extremity, and the distantly separated radiating costæ, with smaller ones between, on the anterior end. I know of no species," he adds, "with which it is liable to be confounded."

The specimens upon which the description of *Grammatodon ? Vancouverensis* was based are said to be from Comox, where they would seem to have been collected by Mr. George Gibbs in 1858. The dimensions of

* Transactions of the Wagner Free Institute of Science, Philadelphia, vol. III, p. 607.

the specimen figured are said to be: length, 0·75 inch; height, 0·47; and breadth or convexity, 0·40 inch.

In the collections made by Sir James Hector during Captain Palliser's explorations, there are two small specimens from "Departure Bay, Nanaimo, V. I.," obtained in 1860, that are probably referable to this species.

Specimens of a small *Arca*, that may be referable to *A. Vancouverensis*, were collected at Hornby and Denman islands by Mr. Richardson, in 1872, and at Extension mine, near Nanaimo, by Mr. Harvey, in 1901. The largest of these is not quite an inch and a half in its greatest length. But it is still uncertain whether the two large single valves from Blunden Point, V. I., that are figured on plate 19 (figs. 1 and 1*a*) of the second part of this volume, and two casts of the interior of large single valves, collected on the Saable River, V. I., by Mr. Richardson, in 1872, should be regarded as adult specimens of *A. Vancouverensis*, or as a distinct species. These large shells have precisely the same kind of hinge dentition as the much smaller specimens, a character upon which Conrad based his genus *Nemodon*.

A cast of the interior of the left valve of a small *Arca* from Departure Bay, V. I., collected by Mr. Harvey, in 1901, is very similar in shape to the *Arca* (*Nemodon*) *Cumshewensis* of the Lower Shales of the Queen Charlotte Islands, but in the former the beak is curved distinctly backward.

Cucullæa truncata? Gabb. (Var.)

Cucullæa truncata? Gabb. 1864. Geol. Surv. Calif., Palæont., vol. 1, p. 196, pl. 25, fig. 182.

Cucullæa (Idonearca) truncata, Whiteaves. 1879. This volume, pt. 2, p. 165, pl. 19, figs. 2 and 2*a*.

Cucullæa truncata? (Gabb) White. 1889. Bull. U.S. Geol. Surv. No. 51, p. 38.

Cfr. *Cucullæa ponderosa*, Whiteaves. 1900. This volume, pt. 4, p. 294, pl. 38, figs. 1 and 1*a*.

In the second part of this volume the writer referred specimens of a rather large and thick shelled species of *Cucullæa*, from several localities in the Vancouver Cretaceous, to the *C. truncata* of Gabb. Similar specimens have since been collected, at the Sucia Islands, in 1894, by Dr. Newcombe; on Vancouver Island, in 1901, at Brennan Creek by the Rev. G. W. Taylor, and six or seven miles north-west of Wellington by Mr. T. Bryant; also at Yorke's Farm, two miles and a quarter to two miles and a half up the Nanaimo River, by Mr. Harvey.

But, as pointed out on pages 295 and 296 of the fourth part of this volume, "there are now some reasons for thinking that the specimens from the Nanaimo group of the Vancouver and Sucia Islands Cretaceous

may be specifically, or at any rate varietally distinct from the true *C. truncata*." "Through the kindness of Prof. Pilsbry, the writer has recently been able to examine and study ten authentic examples of that species, from Cottonwood Creek, the property of the Academy of Natural Sciences of Philadelphia. The largest of these specimens, however, is only forty-nine millimetres in length, by thirty-six mm. in height, inclusive of the umbones." "They seem to differ from the Maud Island specimens," (there described and figured by the writer under the name *C. ponderosa*) and from those from Vancouver and the Sucia Islands that have been referred to *C. truncata*, in their uniformly smaller size, and more particularly in their proportionately narrower and more pointed umbones. The specimens from the Vancouver Cretaceous may not be distinct from the still larger and thicker fossils from the Queen Charlotte Islands, which the writer has called *C. ponderosa*, but it is quite possible that both may be only geographical and stratigraphical varieties of *C. truncata*.

Mytilus pauperculus, Gabb.

Mytilus pauperculus, Gabb. 1864. Geol. Calif., Palæont., vol. I, p. 183, pl. 25, fig. 165.
" " Whiteaves. 1879. This volume, pt. 1, p. 167.

A few detached valves of a small smooth *Mytilus*, that are probably referable to *M. pauperculus*, were collected on the Trent River, V.I., by Mr. Richardson in 1872; at the Sucia Islands, by Mr. Richardson in 1874 and Dr. Newcombe in 1894; and at Texada Island by Mr. Harvey in 1901. As compared with Mr. Gabb's figure of *M. pauperculus*, the specimens from these localities are proportionately a little higher, more angular at the termination of the cardinal border above, and a little less elongated.

Modiola Siskiyouensis, Gabb.

Plate 48, fig. 2.

Modiola Siskiyouensis, Gabb. 1864. Geol. Sur., Calif., Palæont., vol. I, p. 184, pl. 30, fig. 260.

Brennnan Creek, V.I., Rev. G. W. Taylor, 1901 : a small but perfect and well preserved left valve, which is probably referable to this species. It is, however, less than half the size of the type of that species, being only eighteen millimetres and a half long, by nine and a half high, and its posterior umbonal ridge is not very clearly defined. A very imperfect and badly preserved but much larger specimen, from the roof of the coal at the Nanaimo mines, collected by Mr. Harvey, in 1901, is also probably referable to *M. Siskiyouensis*.

Modiola (Brachydontes). Species undeterminable.

The two specimens, one from Hornby Island, and the other from the Sucia Islands, that were referred to *M. ornata*, Gabb, on page 167 of the second part of this volume, are too small and fragmentary to be satisfactorily determined. The larger of them is only nine millimetres in length. A similar specimen has recently been collected by Mr. Harvey, from the roof of the coal at the Nanaimo mines.

Lithodomus nitidus. (N. Sp.)

Plate 48, fig. 3.

Shell moderately elongated, about twice as long as high : superior and ventral borders horizontal, straight and nearly parallel for the greater part of their length; anterior end rounded; posterior end somewhat obliquely subtruncate above and narrowly rounded below; umbones obliquely depressed, beaks anterior and nearly or quite terminal.

Surface lustrous, shining, and marked with concentric raised lines of growth. Test very thin.

Hinge dentition and muscular impressions unknown.

Roof of coal, Nanaimo mines, W. Harvey, 1901 : four well preserved but imperfect and crushed specimens, none of which shew the normal and proportionate convexity of the valves.

Inoceramus digitatus (Sowerby) Schmidt.

Inoceramus digitatus (Sowerby) Schmidt. 1873. Ueb. die Petref. der Kreide-form. von Sachalin, in Mem. Acad. Imper. des Sciences de St Pétersbourg, vol. xix, No. 3, p. 25, pl. 5, figs. 10 and 11, and the whole of plates 6 and 7.

Inoceramus undulatoplicatus (F. Roemer) Schluter. 1877. Kreide-Bivalven zur Gattung *Inoceramus*, p. 22, pl. 3, fig. 1.

" " Whiteaves. 1879. This volume, pt. 2, p. 168, pl. 20, figs. 2 and 2 *a*.

Inoceramus mytilopsis, Whiteaves. 1879. Idem, p. 169, pl. 20, fig. 3 ; but probably not *I. mytilopsis*, Conrad, if that shell is the same as *I. labiatus*, Schlotheim.

Inoceramus digitatus (Sowerby) Jimbo. 1894. Beitr. zur Kenntniss der Fauna der Kreide-form. von Hokkaido, in Dames and Kayser's Palæont. Abhandl. (Jena), Neue Folge, Band II, heft 3, p. 43, pl. 8 (24), figs. 8-10.

" " Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 121.

The following remarks are from the publication last cited.

"The specimens of this species collected by Mr. Richardson on Vancouver Island in 1871 and 1872, and referred to in the second part of this volume are nearly all of small size, though one individual from Blunden Point, as there stated, is fully five inches and a half in height. Some of them are higher than long, with a short hinge-line, and others longer than high, with a long hinge-line. Their sculpture also is equally variable, and consists either of continuous, concentric or radiating and divergent plications, or of corresponding rows of tubercules, in addition to the lines of growth."

"In a paper on 'Cretaceous Fossils from the Vancouver Island region,'* Dr. C. A. White doubts the correctness of the identification of the specimens collected by Mr. Richardson with *I. undulatoplicatus*, but they agree very well with Roemer's description, though perhaps not quite so well with his figure of that species.

"However this may be, several small *Inocerami*, which are evidently conspecific with those collected by Mr. Richardson, were obtained by Dr. C. F. Newcombe, in 1892, on the Comox River, V.I., and kindly presented by him to the Museum of the Geological Survey. With one exception, these specimens from Comox are all longer than high and have a long hinge-line. Their sculpture consists of concentric plications, which are rarely quite parallel with the closely and regularly disposed impressed lines of growth, upon the umbonal and central regions of each valve, and of radiating and divergent folds anteriorly.

"The only specimen collected by Dr. Newcombe on the Comox River that is higher than long, with a short hinge-line, has very peculiar sculpture. In addition to the ordinary growth-lines, a nearly central and continuous longitudinal plication runs from the beak of the left valve (the only one preserved) to the base, a little in advance of the centre of the latter. On the anterior side, five simple plications radiate obliquely forward and outward from this subcentral fold, and on the posterior side four plications, three of which are simple and one bifurcating, radiate also obliquely forward and outward from it.

"In a letter received in August (1894) the writer was informed by Mr. T. W. Stanton (of the U.S. Geological Survey) that he had been recently studying a number of specimens of *Inocerami* with divergent radiating plications, from the Niobrara shales of Colorado, that he has no hesitation in referring to the *I. digitatus* of Sowerby, as re-defined and figured by Schmidt and Schluter, and that it seems to him quite likely that *I. undulatoplicatus*, Roemer, is only the young of that species. Schluter, in his paper on the Cretaceous *Inocerami*, is, indeed, inclined to keep these two forms separate, but Schmidt (*op. cit.*) regards both *I.*

*Bulletin U.S. Geological Survey, No. 51, pt. 3, p. 37.

undulatoplicatus, Roemer, and *I. diversus*, Stoliczka, as mere synonyms of *I. digitatus*. Mr. Stanton adds, in effect, that although none of Schmidt's figures of *I. digitatus* exactly duplicate those of *I. undulatoplicatus* in the 'Mesozoic Fossils,' it still seems to him most likely that the Vancouver specimens are young individuals of *I. digitatus*, a conclusion in which the present writer entirely concurs."

Similar specimens were collected in 1901, at Extension Tunnel, near Nanaimo, by Mr. Harvey; and at Brennan Creek, V.I., by the Rev. G. W. Taylor. One of these specimens from Extension, which is nearly four inches and a quarter high, and apparently about as long as high, is very similar to some of the Saghalien specimens of *I. digitatus* that are figured by Dr. Schmidt. A fragment of a valve that is probably referable to this species and that shows its characteristic surface markings, was collected at the west end of Lasqueti Island by Dr. G. M. Dawson in 1885.

The specimen from Blunden Point collected by Mr. Richardson in 1872, and the two specimens from Extension recently collected by Mr. Harvey, are the only large ones from Canada that the writer has seen, though small ones, that are not much more than two inches in their greatest diameter, and usually less, are not uncommon in the Vancouver Cretaceous.

A few small specimens, with numerous fine concentric ridges but no indications of any divaricating plications, that were referred to *I. mytilopsis*, Conrad, in the second part of this volume, were collected at the Trent River and Bradley Creek, V. I., by Mr. Richardson, in 1872.* They are probably young specimens of *I. digitatus* in which the divaricating plications are not yet developed, such as are figured by Schmidt on Tafel VII, figs. 8, 9 and 10, of his memoir on the Cretaceous rocks of Saghalien. Similar specimens were collected on the Puntledge River, near Comox, by Dr. Newcombe and Mr. Harvey, in 1892.

The specimen from the Nanaimo River referred to by Mr. Etheridge as "No. 22, *Inoceramus mytilopsis*," in one of the lists of fossils in Sir James Hector's paper "On the Geology of the Country between Lake Superior and the Pacific Ocean," and in Captain Palliser's official report, as elsewhere stated,† is a very small right valve of *Inoceramus Vancouverensis*.

Inoceramus subundatus, Meek.

Inoceramus subundatus, Meek. 1861. Proc. Acad. Nat. Sc. Philad., vol. XIII, p. 315.
Inoceramus Crippsii? var. *subundatus*, Meek. 1876. Bull. Geol. and Geogr. Surv. Terr., vol. II, No. 4, p. 358, pl. 3, figs. 1 and 1 *a*, 3 and 3 *a*.

*Not 1871, as inadvertently stated on page 169 of the second part of this volume.

†In the Transactions of the Royal Society of Canada for 1895, Second Series, vol. I, sect. IV, p. 112.

Inoceramus Crippsii, var. *proximus*, Whiteaves. 1879. This volume, pt 2, p. 172.
" var. *Suciensis*, Whiteaves. 1879. Idem, p. 173.
" var. *Barabini*, Whiteaves. 1879. Ibid. p. 173.

Inoceramus subundatus (Meek) Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 112.

The specimens of this species that were described and figured by Meek, are from Comox, V. I., and the Sucia Islands, where they would appear to have been collected by Mr. George Gibbs in 1858. Among the collections made by Sir James Hector, in 1860, during Captain Palliser's explorations, there are four small slabs of argillaceous shale from the Nanaimo River which have upon one or both sides numerous small valves which correspond very well with Meek's illustrations of *I. subundatus*. Mr. Richardson obtained specimens of it at Denman Island in 1891 ; two miles and a quarter up the Nanaimo River, in the lower part of the Trent River, and at Blunden Point, V.I., in 1872. At the Sucia Islands, specimens were collected by Mr. Richardson in 1874, and by Dr. Newcombe in 1894.

Inoceramus Vancouverensis, Shumard.

Inoceramus Vancouverensis, Shumard. 1858. Trans. Acad. Sc. St. Louis, vol. I, p. 123.
Inoceramus unduloplicatus, Etheridge. 1861. In Hector's paper, Quart. Journ. Geol. Soc. London, vol. XVII, p. 434; but not *I. undulatoplicatus*, Roemer, 1852.

Inoceramus mytiloides, Etheridge. 1861. Idem, p. 34; but not *I. mytiloides*, Mantell, 1852.
Inoceramus Vancouverensis, Whiteaves. 1879. This volume, pt. 2, p. 170, pl. 20, figs. 4, 4 *a* and 4 *b*.

Inoceramus Nebrascensis, var. *Sagensis*, Whiteaves. 1879. Idem, p. 172 (a typ. err. for *I. Sagensis*, var. *Nebrascensis*); but probably not *I. Nebrascensis*, Owen.
Inoceramus Vancouverensis, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series , vol. I, sect. IV, p. 111.

The types of *I. Vancouverensis* are said to have been collected at Nanaimo by Dr. John Evans, U. S. Geologist, and they obviously could not have been obtained later than 1857.

As stated in the Transactions of the Royal Society of Canada for 1895, (op. cit. supra), in one of the collections made during Captain Palliser's explorations there are three specimens which are apparently referable to *I. Vancouverensis*. One of these is a very imperfect left valve labelled " No. 20, *Inoceramus undulato-plicatus*, septarian clay (above the lignite), Nanaimo River, Dr. Hector, 1860." The umbo of this valve is not so tumid as is usual in this species, and the surface markings consist of low, distant, concentric undulations, but there are no indications of any radia-

ting and divaricating folds. The other two are very small right valves from essentially the same locality, one labelled "No. 22, *Inoceramus mytilopsis*," and the other "*Isocardium*." Both have the prominent umbo characteristic of *I. Vancouverensis*, and the latter evidently corresponds to the latter part of the entry, "Also *Nautilus* and *Incardium*" (a typographical error for *Isocardium*), after No. 29 in the list of specimens on page 243 of Captain Palliser's report.

The right valve from the Sucia Islands referred to *I. Sagensis*, var. *Nebrascensis*, on page 172 of the second part of this volume, is a broad variety of *I. Vancouverensis*.

In 1871–75, specimens of this species were collected by Mr. Richardson two miles and a-half up the Nanaimo River, V. I., at Protection, Salt Spring (or Admiralty), Saturna, and the Sucia Islands; also in 1901, by Mr. Harvey, at Yorke's Farm, two miles and a quarter to two miles and a half up the Nanaimo River.

Pecten Traskii, Gabb.

Pecten Traskii, Gabb. 1864. Geol. Surv. of Calif., Palæont., vol. I, p. 200, pl. 26, fig. 187; and (1869) vol. II, p. 198, pl. 32, fig. 95.

Texada Island, W. Harvey, 1901: one small lower valve.

Lima Suciensis. (N. Sp.)

Plate 51, fig. 2.

Shell small, moderately convex but slightly compressed, obliquely subovate, posterior side somewhat produced below, larger and more narrowly rounded than the anterior; beaks incurved, ears small.

Surface markings consisting of small, narrow, radiating ribs, that are everywhere crossed by concentric striæ or lines of growth. From eleven to fourteen of these ribs are a little larger than the rest, and in testiferous specimens the spaces between them, when examined with a lens, are seen to be occupied by from four to six low and close-set, minute, radiating ridges. Characters of the interior of the valves unknown.

Sucia Islands, Dr. C. F. Newcombe, 1876: three casts of the interior of both valves. Extension mine, near Nanaimo, W. Harvey, 1901: a cast of a left valve. Texada Island, W. Harvey, 1901: an imperfect but testiferous left valve. The largest of these is less than one inch in its greatest diameter.

Lima. (Species indeterminable.)

A single specimen of a rather large species of *Lima*, apparently of the *Plagiostoma* group, collected by Mr. Richardson, in 1872 (not 1871), at the entrance to Departure Bay, V.I., was referred to *L. multiradiata*, Gabb, with a query, on page 174 of the second part of this volume. This identification, however, is far from satisfactory, as only a very small piece of the test is preserved on the Canadian fossil.

Two very similar specimens, except that they are mere casts of single valves, without any portion of the test preserved, were collected by Mr. Harvey, in 1901, at Extension mine, three miles south-west of Nanaimo, V.I. Both of these casts, which are now in the Museum of the Survey, are marked by very numerous, narrow, radiating ribs. In one of them, seven or eight of the ribs are a little larger than the rest, and in the other the ribs are rather irregular in size and distribution.

Spondylus. (Species uncertain.)

Cfr. *Spondylus fragilis*, Stanton. 1896. Bull. U. S. Geol. Surv. No. 133, p. 35, pl. II, fig. 3.

Among the fossils collected during Captain Palliser's explorations a "small piece of glauconitic rock labelled No. 48 (below the Lignite), Departure Bay, Nanaimo ; *Ostrea bella*, Conrad ; Dr. Hector, 1860 ; coll., Mr. Mackay—contains a few valves or fragments of valves of a species of *Ostrea*, and a single valve of a shell whose generic and specific relations are uncertain. This valve is sixteen lines and a half in length and about fourteen and a half in breadth. It is moderately convex, but with a rather broad, shallow, transverse constriction a little in front of the mid-length, obliquely subovate in outline, a little longer than broad, and the extremely thin test is marked with fine radiating raised lines, about three in the breadth of a millimetre, which are minutely bifurcating anteriorly, when viewed with a lens. It is much more finely ribbed than the convex valve of *Ostrea bella*, if Conrad's figures are correct, and indeed its surface markings are not at all like those of an *Ostrea*. A fragment of a much larger specimen in the collection, from the same locality and apparently belonging to the same species, has essentially the same sculpture on the *interior* of the shell as the *Spondylus complanatus* of d'Orbigny,* from the French Neocomien. Another specimen in the collection, from the same locality and possibly also belonging to the same species, is the No. 41 of the list of specimens on page 243 of Capt. Palliser's report. It is a rough cast of the interior of one valve, about

*Paléontologie Française, Terr. Crét., vol. III, p. 657, pl. 451, figs. 7-10.

two inches and a quarter in length and an inch and a half in its greatest breadth. It is longitudinally subovate, but rather irregular in outline, its umbonal region is prominent, and its surface shows impressions of somewhat narrow, flexuous, radiating ribs." *

These three specimens, and the two collected at practically the same locality by Mr. Richardson, and referred to on page 175 of the second part of this volume as "HINNITES or SPONDYLUS (Sp. Undt.)," agree fairly well with Dr. Stanton's description and figure of *S. fragilis*, but they are too imperfect and badly preserved to be determined with much certainty. Similar but better specimens, now in the Museum of the Survey, were collected at Extension mine, near Nanaimo, by Mr. Harvey, in 1900, and apparently in the same kind of rock.

EXOGYRA PARASITICA, Gabb.

Exogyra parasitica, Gabb. 1864. Geol. Surv. Calif., Palæont., vol. I, p. 205, pl. 26, figs. 192 and 192 *a*, *b*; and pl. 31, figs. 273 and 273 *a*.

Exogyra (Sp. undt.) Whiteaves. 1879. This volume, pt. 2, p. 175.

The single valve of an *Exogyra* from the entrance to Departure Bay, referred to on page 175 of the second part of this volume, and two specimens with both valves since collected at the Sucia Islands by Dr. Newcombe (in 1896) are probably referable to *E. parasitica*, though in one of the latter, a part at least of the attached valve is radiately costate.

GRYPHÆA VESICULARIS, Lamarck.

Ostrea vesicularis, Lamarck. 1806. Ann. Mus., vol. VIII, p. 160, pl. 22, fig. 3; and (1819) Hist. An. Sans Verteb., vol. VI, p. 219.

" " Goldfuss. 1826. Petref. Germ., vol. I, p. 23, pl. 81, fig. 2.

" " D'Orbigny, Pal. Franc., Terr. Crétac., vol. III, p. 742, pl. 487, figs. 1 and 2, but not figs. 6, 8 and 9.

Ostrea convexa, Say. 1820. Amer. Journ. Sc. and Arts, vol. II, p. 42.

Gryphæa convexa, Morton. 1828. Journ. Ac. Nat. Sc. Philad., vol. VI, p. 79, pl. 4, figs. 1 and 2, and pl. 5, figs. 1-3; also (1834) Synops. Org. Rem. Cret. Gr. U. S., p. 53, pl. 4, figs. 1-2.

Gryphæa mutabilis, Morton. 1828. Journ. Ac. Nat. Sc. Philad., vol. VI, p. 81, pl. 4, fig. 3: and (1834) Synops. Org. Rem. Cret. Gr. U. S., p. 53, pl. 4, fig. 3.

Gryphæa vesicularis, Meek. 1876. Rep. U.S. Geol. Surv., Terr., vol. IX, p. 20 (which see, for several European and U. S. synonyms, not included in this list), pl. 11, figs. 2 *a*, *b*, *c*, and pl. xvi, figs. 8, *a-b*.

Gryphæa vesicularis, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. IV, p. 120.

"Howe Sound, Mr. J. Fannin, 1884: one lower valve, about fifty-one millimetres long and fifty-seven broad. It is ovately subtriangular in

*Transactions of the Royal Society for 1895, Second Series, vol I, sect. IV, pp. 110, 111.

outline, broader than long, and its posterior side is produced and somewhat pointed below. Nanaimo, V.I., two specimens ; one a very gibbous lower valve, sixty-five mm. long and forty-two broad ; the other, seventy millimetres in length by forty-nine in breadth, with both valves preserved *in situ*, but with a much less convex lower valve ; both of them elongate subovate in marginal outline and almost equilateral. In two of the specimens the lower valve is strongly and regularly convex, but it is not lobed posteriorly by a distinct longitudinal groove or sinus on or near the front margin, in either of the three.

"These free and narrowly convex shells look very different to the broad, irregularly subhemispherical specimens, with a broad surface of attachment to the umbo of the lower valve, from the Fort Pierre group of the Dakota Cretaceous, which Mr. Meek referred with some doubt to *O. vesicularis*. Still they correspond fairly well with Goldfuss' description and figures of the typical form of that species, which he calls the "var. *A.*," and describes as "*testa rostrata libera* ;" also with Morton's figures of *G. convexa*, Say, and with one of Stoliczka's figures (Cret. Faun. S. India, pl. 42, fig. 4) of *O. vesicularis*" (1896, op. cit. supra).

Anomia Vancouverensis, Gabb.

Anomia Vancouverensis, Gabb. 1869. Geol. Calif., Palæont., vol. II, p. 202, pl. 33, fig. 102.
" " Whiteaves. 1879. This volume, pl. 2. p. 175.

Two upper valves of a small species of *Anomia*, that are probably referable to *A. Vancouverensis*, were collected at Texada Island by Mr. Harvey in 1901. Both are irregular in outline and marked only with concentric lines of growth, while the beak of each is very nearly marginal.

BRACHIOPODA.

Rhynchonella Suciensis, Whiteaves.

Plate 51, figs. 3, 3 *a* and 4.

Rhynchonella (Sp. undt.). Whiteaves. 1879. This volume, pt. 2, p. 177.
Rhynchonella Suciensis, Whiteaves. 1896. Trans. Royal Soc. Canada for 1895, Second Series, vol. I, sect. iv, p. 119, pl. 3, fig. 1.

The original description of this species is as follows :—

"Shell moderately convex, subovate, with an apparently feebly developed mesial fold and sinus. Ventral valve a little longer than broad, with a narrow, elongated and nearly straight beak ; dorsal valve broader than long, with a comparatively obtuse and incurved beak. Surface markings of both valves consisting of numerous (about twenty-two) narrow, pro-

minent, acute raised ribs, which extend from the beaks to the anterior margin.

"Sucia Islands, J. Richardson, 1874, one rather small but perfect specimen and two single valves; and Dr. C. F. Newcombe, 1894, six single valves."

The largest of these specimens, it may be added, is not quite seventeen millimetres in its maximum diameter, and it is now obvious that none of them are quite full grown.

A few badly preserved specimens of a *Rhynchonella*, which are probably referable to this species and which are now in the Museum of the Survey, were collected at three different localities on Vancouver Island in 1901. Four of these are from Brennan Creek, where they were collected by the Rev. G. W. Taylor. The largest of them is the original of figures 3 and 3 *a* on Plate 51. It is transversely subelliptical, wider than high, about 25·5 mm. wide by 20·5 high, and has upwards of thirty ribs. In this specimen and in another apparently adult shell from the same locality, there is no mesial fold or sinus. One small specimen, about 10 mm. long and slightly longer than wide, with very fine ribs, from Departure Bay, and another, a little larger and rather more coarsely ribbed specimen, from the roof of the coal at the New Vancouver Coal Company's mine, were collected by Mr. Harvey.

A crushed specimen of a *Rhynchonella* from Tucker Bay, Lasqueti Island, collected by Mr. Harvey in 1901 and now in the Museum of the Survey, is probably only a rather coarsely ribbed variety of *R. Suciensis*. It is 20·5 mm. long by 20 broad, and has only fifteen or sixteen ribs.

Terebratella Harveyi. (N. Sp.)

Plate 51, figs. 5 and 6.

Shell inequivalve, minutely punctate, subcircular or somewhat fan-shaped, rounded in front and at the sides, but bluntly pointed behind.

Ventral valve deeper and a little larger than the dorsal, its umbo moderately prominent or produced, and its surface marked with from twelve to fourteen simple or bifurcating ribs or rib-like folds, and concentric lines of growth. The beak, or apex of the umbo, and the foramen and area of this valve are not preserved in any of the specimens that the writer has seen, but a cast of the interior of a ventral valve shews a transverse constriction of the umbo, and a narrow divergent groove or slit on each side of it.

Dorsal valve nearly flat, its cardinal border straight, its beak very small, and its surface ornamentation similar to that of the ventral. A cast of

the interior of the dorsal shews only a fine, linear, median groove, extending longitudinally from the beak almost to the midlength, and indicating a rather short mesial septum.

Extension mine, Nanaimo, eleven imperfect specimens; and Texada Island, four similar specimens; all collected by Mr. Harvey in 1901.

Kingena occidentalis. (N. Sp.)

Plate 51, figs. 7 and 7 *a*.

Terebratula Wacoensis, Whiteaves. 1879. This volume, pt. 2, p. 177; but probably not *T. Wacoensis*, Roemer, 1852.

Shell compressed convex, broadly subelliptical and somewhat pentagonal, a little longer than wide and about twice as wide as high (or deep), subtruncate in front and bluntly pointed behind.

Ventral valve not much more convex exteriorly than the dorsal, the umbo of the former short, obtuse, and very slightly incurved, but its apex or beak is unfortunately broken off in the only specimen collected. Dorsal valve with a very small and slightly incurved beak, which is divided interiorly and longitudinally by a median septum, that extends about half way to the front margin. Surface everywhere minutely punctate, when examined with a lens.

Approximate dimensions of the only specimen known to the writer: maximum length, about sixteen millimetres: greatest breadth, about fourteen mm.; maximum convexity of both valves when closed, seven mm.

Trent River, V. I., J. Richardson, 1871: the specimen referred to in the second part of this volume, which was provisionally identified with the *Terebratula Wacoensis* of Roemer, which Schuchert has shown to be a *Kingena*. A subsequent comparison of this fossil with numerous authentic Texan examples of *K. Wacoensis*, presented to the Museum of the Survey by Prof. R. J. Hill, in 1889, has, however, led to the conclusion that the former should be regarded as a probably distinct and previously undescribed species, characterized chiefly by its smaller size, narrower and less convex lateral margins, and much more strongly compressed valves. Dr. Stanton and Mr. Schuchert, who have examined and studied the specimen upon which the foregoing description is based, agree in thinking that it is distinct from *K. Wacoensis*. The marginal contour of *K. occidentalis* is somewhat similar to that of the form of *K. lima* represented by Davidson on plate IV, figs. 24, 24*a*, and 24*c*, of the British Cretaceous Brachipoda, published by the Palæontographical Society, but the valves of the former are much more compressed, and the umbo of its ventral valve is less incurved.

POLYZOA.

A badly preserved specimen of the zoarium of a cheilostomatous polyzoon that Mr. R. S. Bassler, of the U. S. National Museum, thinks is a *Membranipora* of the *M. membranacea* group, was collected at Brennan Creek, V.I., by the Rev. G. W. Taylor in 1901.

ECHINODERMATA.

All the echinoderms from the Vancouver Cretaceous that the writer has yet seen, are a few fragments.

The Echinoidea are represented by two or three small pieces of the test of a regular echinid, from Departure Bay, V.I., collected by Mr. Harvey in 1901. These fragments, which in some respects are like portions of the test of a *Pseudodiadema*, shew two vertical rows of small tubercles alternating with the ambulacra. In *Pseudodiadema* the tubercles are both crenulated and perforate, but in the fragments from Departure Bay, although the tubercles are clearly perforate, the outer surface is so much worn that it is doubtful whether they are crenulated or not.

The Starfishes are represented by a specimen shewing most of the calcareous plates of one ray of a five-rayed species from Lasqueti Island, collected by Dr. G. M. Dawson in 1885. In reference to this specimen Dr. J. W. Gregory writes as follows, in a letter dated July 18, 1899. "It is no doubt a starfish of the family Pentagonasteridæ and a close ally of the genus *Calliderma*. But I believe it to indicate a new genus characterized by the smaller size of the marginal plates, and almost equal size of the internal plates. The pedicellariæ also are different. If at any time more specimens are forthcoming, shewing especially the external form, I should be glad to do more with the fossil. A very little more would have enabled me to form a tolerably definite idea whether the rays were much prolonged or not."

The Crinoidea are represented by a single five-lobed joint of the column of a Pentacrinite, and a fragment of the basal portion of the dorsal cup of a Pentacrinite or some other crinoid, both on the same small piece of rock, which was collected at Lasqueti Island by Mr. Harvey in 1901.

ANTHOZOA.

Smilotrochus (?) Vancouverensis.

Smilotrochus Vancouverensis, Whiteaves. 1879. This volume, pt. 2, pl. 20, figs. 7 and 7*a*.

The type and only known specimen of this species at that time, was collected at Hornby Island, by Mr. Richardson, in 1871. Of later years a fine specimen of *S. Vancouverensis* has been collected at the same locality by Mr. Harvey, in 1895.

ERRATA.

Page 312.
Line 21, from top, for "Upper Missouri County,"—read—Upper Missouri country.

Page 316.
Line two, from bottom, for "specimen No. 4,"—read—specimen No. 2.

Page 321.
Line three, from bottom, for—"from the same stone,"—read—from the same stone or stones.

Page 338.
Line 20 from top, for "*Hamites subcompressum*,"—read—*Hamites subcompressus*; and on
Line 24, from top, for "*Hamites (Anisoceras) subcompressum*,"—read—*Hamites (Anisocceras) subcompressus.*

Page 367.
Line 18, from top, for "Var. *carinifera*,"—read—Var. *cariniferus.*

List of fossils from the Nanaimo group of the Vancouver Cretaceous, exclusive of plant remains.*

FISHES.

Vertebræ of a teleost.
Asterospondylic vertebra of shark.
Lamna appendiculata, Agassiz.

CRUSTACEA.

DECAPODA.

Plagiolophus Vancouverensis, H. Woodw.
Palæocorystes Harveyi, H. Woodw.
Callianassa Whiteavesii, H. Woodw.
Hoploparia Bennetti, H. Woodw.
Enoploclytia minor, H. Woodw.
Eryma Dawsoni, H. Woodw.
Meyeria (?) Harveyi, H. Woodw.
Glyphæa, sp. nov.
Linuparus Vancouverensis.
Linuparus Canadensis.

MOLLUSCA.

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Belemnites, sp. indet.
Nautilus Campbelli, Meek.
" Suciensis.
Phylloceras ramosum, Meek.
" Forbesianum (d'Orbigny).
Gaudryceras Maclurei (White).
" Denmanense.
Tetragonites Timotheanus? (Mayor).
Pseudophyllites Indra (Forbes).
Heteroceras elongatum.
" Hornbyense.
Hamites obstrictus, Jimbo.
Diplomoceras notabile.
Ptychoceras Vancouverense.
Anisoceras subcompressum (Forbes).
Anisoceras Cooperi (Gabb).
Baculites Chicoensis, Trask.
Hoplites Vancouverensis (Meek).
Pachydiscus Otacodensis (Stoliczka).
" Neevesii.
" Suciensis (Meek).
" Haradai, Jimbo.
" (Haradai, var. ?) perplicatus.
" binodatus.
" Newberryanus (Meek).
" multisulcatus.
Desmoceras Selwynianum.
Pleuropachydiscus Hoffmanni (Gabb). Var.
Hauericeras Gardeni (Bailey).

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Cylichna costata, Gabb.
Haminea Hornii? (Gabb).
Cinulia obliqua, Gabb.
Cinuliopsis typica.
Trochactæon semicostatus.
Surcula Suciensis.

* The species to which no author's name is appended have either been described by the writer in previous publications, or are now for the first time described in this Report

Surcula (raricostata ? var.) Hornbyensis.
Bela cretacea.
Rostellites Gabbi (White).
Fusus Kingii, Gabb.
Serrifusus Dakotensis, var. Vancouverensis.
Perissolax brevirostris, Gabb.
Hindsia nodulosa.
Sycodes glaber (Shumard).
Cypræa Suciensis.
Tessarolax distorta, Gabb.
Anchura callosa.
" exilis, Gabb.
Mesostoma Suciense.
Mesostoma (?) intermedium.
Mesostoma (?) Newcombii.
Cerithium Vancouverense.
" Harveyi.
Potamides tenuis, Gabb.
Potamides tenuis, var. Nanaimoensis.
Nerinea dispar, Gabb. Var.
Littorina compacta ? Gabb.
Capulus corrugatus.
Vanikoro pulchella. Var.
Vanikoropsis Suciensis, White.
Lunatia Shumardiana ? Gabb.
Gyrodes Conradiana, Gabb, var. Canadensis.
Amauropsis Suciensis.
Odostomia (?) inornata.
" (?) cretacea.
Lysis Suciensis.
Anisomyon Meekii, Gabb.
Acmæa (?) sp. indet.
Scalaria Mathewsoni, Gabb.
Cirsotrema tenuisculptum.
Eunema cretaceum.
Margarita ornatissima (Gabb).
Solariella (radiatula ? Forbes, var.) occidentalis.
Phaneta (?) decorata.
Helcion giganteus, Schmidt, var. Vancouverensis.
Helcion tenuicostatus.
Genus & species uncertain.

SCAPHOPODA.

Dentalium Nanaimoense, Meek.
Entalis Cooperi (Gabb).

PELECYPODA.

Teredo Suciensis.
Martesia clausa, Gabb.
Martesia parvula.
Corbula Traskii, Gabb.
" minima ? d'Orbigny.
Panopæa concentrica, Gabb.
Cymbophora Ashburneri, Gabb.
Anatina sulcatina ? Shumard.
" quadrata, Gabb.
" Tryoniana, Gabb.
" subcylindracea.
Thracia occidentalis, Meek.
" subquadrata, Meek.
Pholadomya subelongata, Meek.
Goniomya borealis, Meek.
Cuspidaria Suciensis.
Tellina quadrata, Gabb.
" occidentalis.
" Nanaimoensis.
Asaphis multicostata, Gabb.
Linearia (Leiothyris) Meekana.
Meretrix nitida, Gabb.
" arata, Gabb.
Dosinia inflata, Gabb.
" gyrata ? Gabb.
Cyprimeria tenuis, Meek.
" lens.
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" subcircularis, Gabb.
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Clisocolus dubius, Gabb.
" cordatus.
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Crassatella Conradiana, var. Tuscana.
Eriphyla umbonata, Gabb.
Opis Vancouverensis.
Unio Nanaimoensis.
Trigonia Evansana, Meek.
" Tryoniana, Gabb.
Nucula Traskana, Meek.
" Hornbyensis.

Nucula Richardsoni.
Nucula (Acila) truncata, Gabb.
Yoldia striatula, Forbes.
" diminutiva.
Pectunculus Veatchii (Gabb).
Arca Vancouverensis, Meek.
Arca (Cucullæa?) equilateralis, Meek.
Cucullæa truncata, Gabb.
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Mytilus pauperculus, Gabb.
Modiola Siskiyouensis, Gabb.
Modiola (Brachydontes) sp. indet.
Lithodomus nitidus.
Perna excavata, White.
Inoceramus digitatus (Sowerby) Schmidt.
" subundatus, Meek.
" Vancouverensis, Shumard.
Meleagrina antiqua, Gabb.
Pecten Traskii, Gabb.
Lima Suciensis.
Lima, sp. indet.
Spondylus, sp. indet.
Exogyra parasitica, Gabb.
Gryphæa vesicularis, Lamarck.
Anomia Vancouverensis, Gabb.

BRACHIOPODA.

Rhynchonella Suciensis.
Kingena occidentalis.
Terebratella Harveyi.

POLYZOA.

Membranipora, sp. indet.

ECHINODERMATA.

Fragments of test of a regular echinid.
Portion of ray of a five-rayed starfish.
Five lobed joint of column of Pentacrinite.

ANTHOZOA.

Smilotrochus Vancouverensis.

OTTAWA, November 5, 1902.

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(Synonyms in Italics.)

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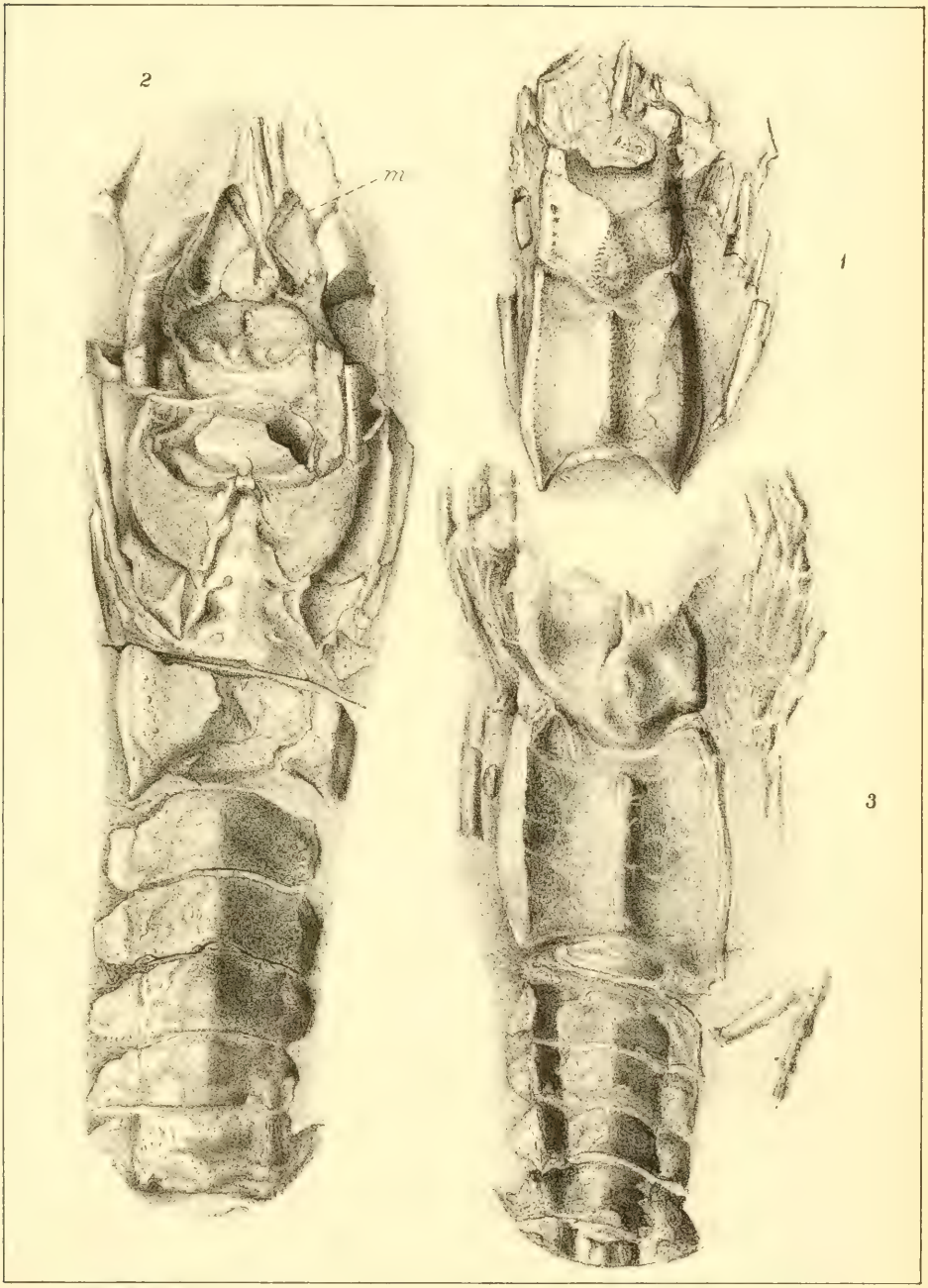
PLATE XL.

LINUPARUS VANCOUVERENSIS (page 323).

Figure 1. Dorsal view of the type of this species, from the Puntledge or Comox River, near Comox, V. I.

Figure 2. The specimen referred to in the text as No. 4, which shews the interior of the cephalothorax, five of the abdominal segments, etc.

Figure 3. Dorsal view of a specimen in the split nodule from Hornby Island, referred to on page 325 as No. 55 *a* and *b*.



G.M.Woodward & H.B.Potter
West, Newman imp

Decapod Crustaceans
U. Cretaceous Vancouver Island, B.C.

PLATE XLI.

LINUPARUS CANADENSIS (page 325).

Figure 1. The specimen from Hornby Island referred to on page 326 as No. 55 *c*, which Dr. Woodward identifies with this species.

ERYMA DAWSONI (page 321).

Figure 2. Profile view of the type and only known specimen of this species, from Hornby Island.

West, Newman imp

Decapod Crustaceans
Cretaceous Comox & Hornby Id. B.C.

PLATE XLII.

HETEROCERAS HORNBYENSE (page 332).

Figure 1. One of the two original and dextral types of this species, shewing only the spirally coiled portion of the shell.

Figure 2. Part of the spirally coiled portion of a sinistral specimen, the type of *H. perversum.*

Figure 3. Spirally coiled portion of another sinistral specimen.

Figure 4. The largest specimen known to the writer, shewing part of the spirally coiled portion, and the free, deflected and abruptly bent or hook-shaped part of the shell, as described on page 333.

All the specimens figured on this plate are from Hornby Island.

L.M.Lambe. Delt

PLATE XLIII.

ANISOCERAS COOPERI (page 336).

Figure 1. Side view of the specimen from Hornby Island collected by Mr. Robbins, and referred to in the last line on page 337, and the first and second lines on page 338.

HINDSIA NODULOSA (page 357).

Figure 2. Ventral view of a specimen from the Sucia Islands, belonging to Dr. Newcombe, that shews the characters of the aperture unusually well.

PERISSOLAX BREVIROSTRIS (page 356).

Figure 3. Dorsal view of the most perfect specimen that the writer has seen, from the Sucia Islands, the property of Dr. Newcombe.

MESOSTOMA (?) INTERMEDIUM (page 360).

Figure 4. One of the best specimens of this species, from the Sucia Islands, twice the natural size.

MESOSTOMA (?) NEWCOMBII (page 361).

Figure 5. Dorsal view of the only specimen of this species known to the writer, from the Sucia Islands.

CERITHIUM VANCOUVERENSE (page 361).

Figure 6. Dorsal view of the type of this species, from Extension mine, near Nanaimo, V.I., twice the natural size.

CERITHIUM HARVEYI (page 362).

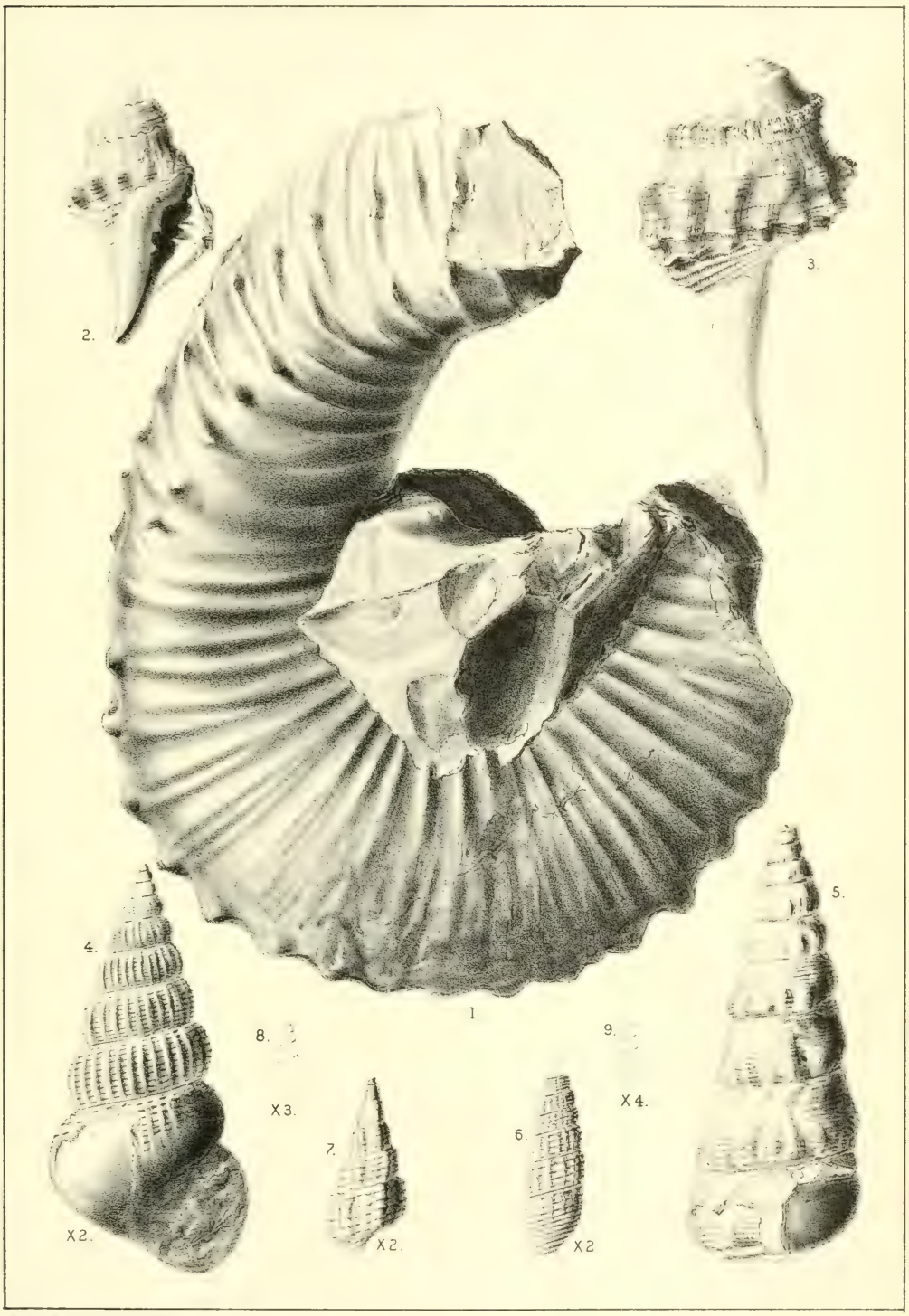
Figure 7. One of the specimens from Nanaimo referred to in the text, twice the natural size.

ODOSTOMIA (?) INORNATA (page 366).

Figure 8. Dorsal view of the only specimen known to the writer, from the Nanaimo River, three times the natural size.

ODOSTOMIA (?) CRETACEA (page 366).

Figure 9. Apertural view of an average specimen from Brennan Creek, V. I., in outline and four times the natural size.



L.M.Lambe. Del.

PLATE XLIV.

ASTEROSPONDYLIC VERTEBRA (page 314).

Figure 1. The centrum from the Puntledge River referred to in the text.

From a drawing by Mr. C. Frank King.

HETEROCERAS ELONGATUM (page 331).

Figure 2. The spiral and closely coiled portion of a sinistral specimen from Hornby Island.

HAMITES OBSTRICTUS (page 334).

Figure 3. Side view of the best specimen that the writer has seen, from Hornby Island.

From a drawing by Mr. F. E. Calderon.

DIPLOMOCERAS NOTABILE (page 335).

Figure 4. Side view of the specimen described, from Hornby Island, seven twelfths the natural size. The sutural lines are exposed on the other side and are best seen at *a*.

" 4 *a*. Outline of transverse section of the same, also seven twelfths the natural size.

" 4 *b*. Sutural line of the same, as far as it can be ascertained, of the natural size.

From a drawing by Mr. C. Frank King.

TROCHACTÆON SEMICOSTATUS (page 354).

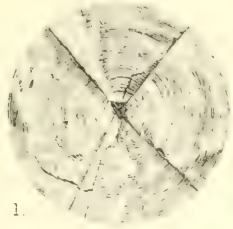
Figure 5. Dorsal view of a specimen from Nanaimo, four times the natural size.

BELA CRETACEA (page 355).

Figure 6. Dorsal view of one of the specimens from Hornby Island, twice the natural size.

MESOSTOMA SUCIENSE (page 359).

Figure 7. Part of a specimen from the Sucia Islands, collected by Dr. Newcombe, with the aperture well preserved.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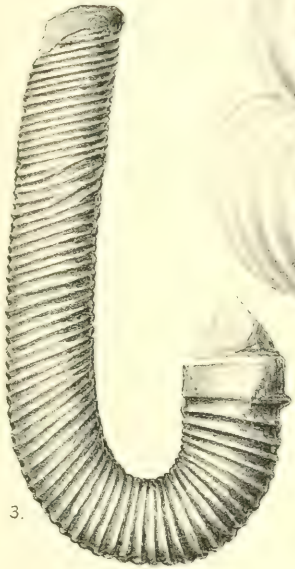
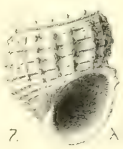

3.

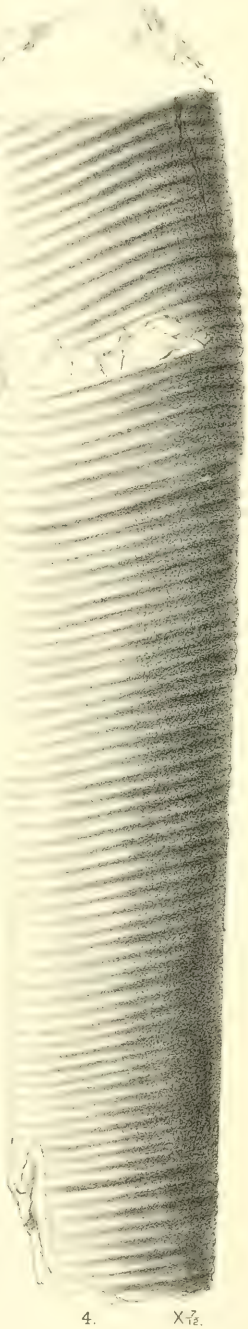
5. X 4.

a 4

6. X 2.


7. X 2.

4a


a

4. X 1/2.

PLATE XLV.

ANISOCERAS SUBCOMPRESSUM (page 338).

Figure 1. Side view of a specimen from the Puntledge River, near Comox, V.I.

" 1 *a*. Outline of a transverse section of the straighter part of the same, a little behind the midlength of the specimen.

" 1 *b*. Outline of a similar section, near the anterior end of the specimen.

All from drawings by Mr. C. Frank King.

CAPULUS CORRUGATUS (page 364).

Figure 2. A specimen from the Puntledge River, as seen from above.

" 2 *a*. Side view of the same, in outline.

LYSIS SUCIENSIS (page 367).

Figure 3. Apertural view of an adult specimen of this species, from the Sucia Islands, collected by Dr. Newcombe.

LYSIS SUCIENSIS, var. CARINIFERUS (page 367).

Figure 4. Dorsal view of a specimen of this variety, from Brennan Creek, V. I., with two short spinous processes on the outer lip, presented by Rev. G. W. Taylor.

SOLARIELLA (RADIATULA ? var.) OCCIDENTALIS (page 368).

Figure 5 Dorsal view of a specimen from Brennan Creek, V.I., presented by Rev. G. W. Taylor, twice the natural size.

" 5 *a*. Basal view of the same.

PHANETA (?) DECORATA (page 369).

Figure 6. Basal view of a specimen of this species, from the Nanaimo mines, V.I., twice the natural size.

" 6 *a*. Dorsal view of the same, in outline, shewing the obtuse apex and peripheral keel.

Figure 7. Another specimen from the same locality, and as seen from above. Twice the natural size.

HELCION TENUICOSTATUS (page 371).

Figure 8. A specimen from Extension mine, as seen from above and twice the natural size.

" 8 *a*. Side view of the same, in outline, shewing the irregular, depressed conical form.

GASTEROPOD, GENUS AND SPECIES UNCERTAIN (page 371).

Figure 9. One of the specimens from the roof of the coal at the Nanaimo mines.

MARTESIA (?) PARVULA (page 372).

Figure 10. Right valve of a specimen of this species, from Extension mine, and twice the natural size.

ANATINA SUBCYLINDRACEA (page 374).

Figure 11. Side view of the most perfect specimen collected, from Brennan Creek, V.I., shewing the left valve.

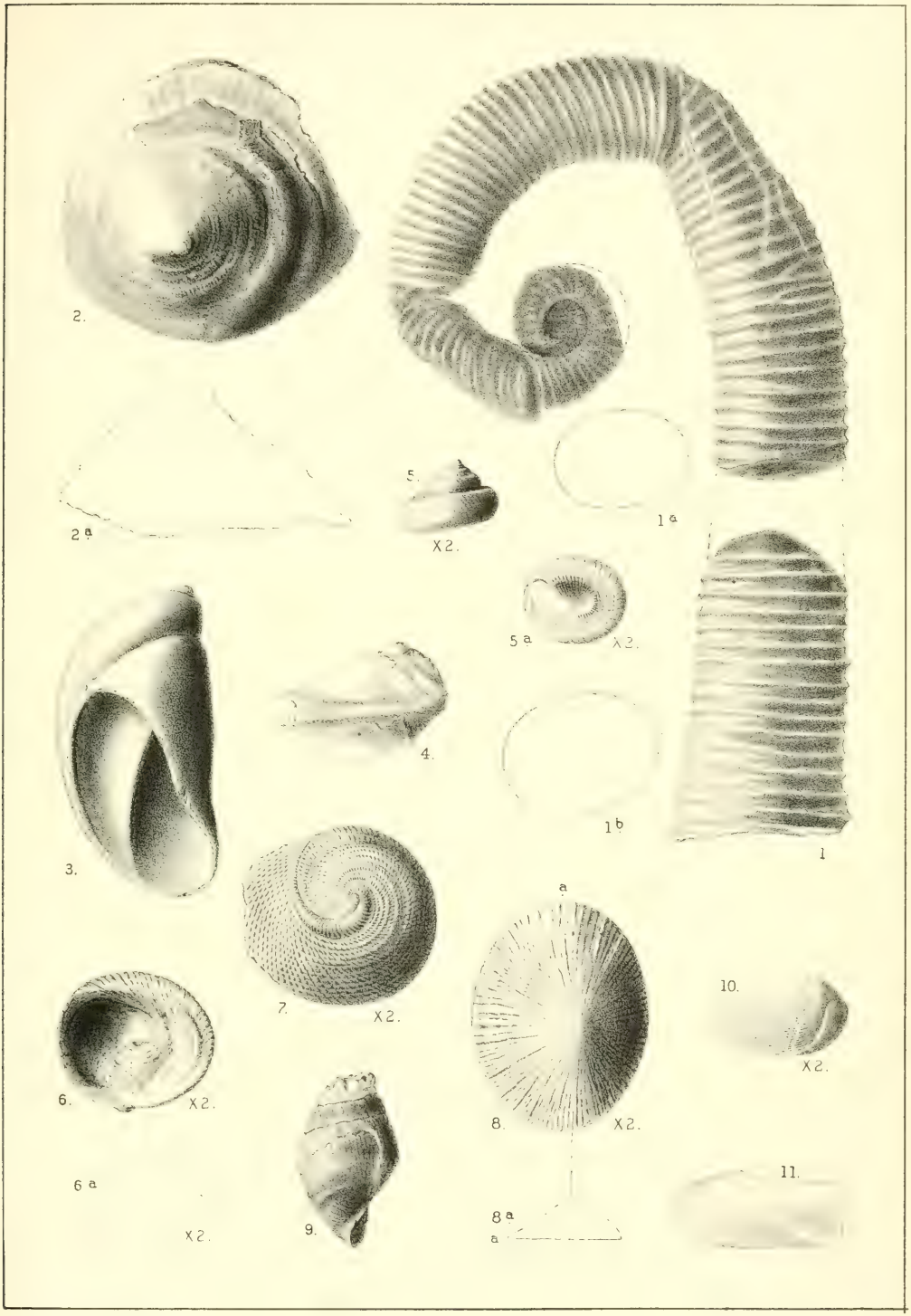


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PLATE XLVI.

PACHYDISCUS OTACODENSIS (page 340).

Figure 1. Side view of the specimen from Hornby Island, presented by Mr. Robbins.

CUSPIDARIA SUCIENSIS (page 376).

Figure 2. The right valve of this species from the Sucia Islands, as described in the text, but twice the natural size.

TELLINA NANAIMOENSIS (page 376).

Figure 3. Side view of the type of this species, from the Nanaimo River, V. I., and shewing the right valve.

NUCULA HORNBYENSIS (page 388).

Figure 4. Side view of an apparently adult shell of this species, from Hornby Island, and twice the natural size.

2.
X2
4.
X2.
3.
1.

PLATE XLVII.

PACHYDISCUS NEEVESII (page 342).

Figure 1. Side view of the type of this species, from James Island, nine twelfths the natural size.

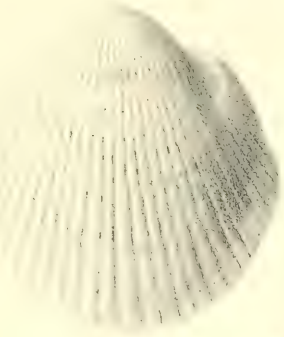
YOLDIA DIMINUTIVA (page 390).

Figure 2. The left valve from Nanaimo upon which this species is based, four times the natural size.

PECTUNCULUS VEATCHII (page 391).

Figure 3. Side view of an adult specimen of this shell, from Blunden Point, V. I., collected by Mr. James Richardson in 1872.

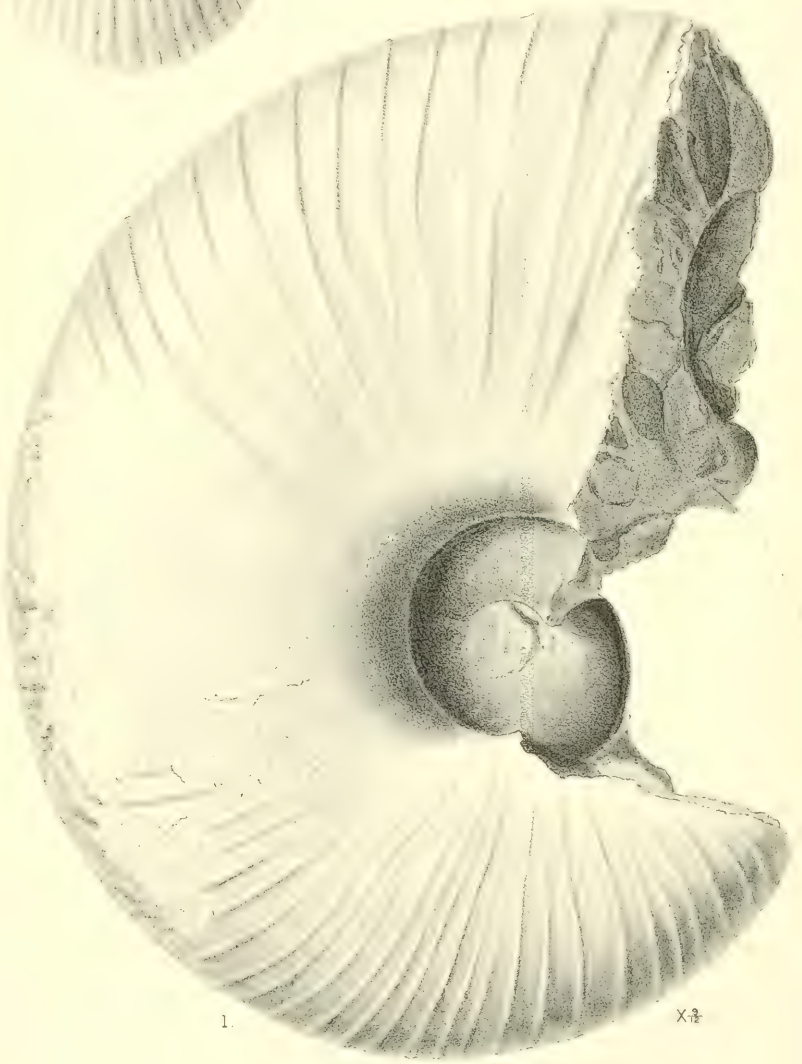
Figure 4. Portion of the surface markings of a specimen from Texada Island, four times the natural size, and shewing the minute cancellation of the exterior.



3.

4. X 4.

2. X 4.



1. X $\frac{3}{12}$

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PLATE XLVIII.

PACHYDISCUS (HARADAI? VAR.) PERPLICATUS (page 346).

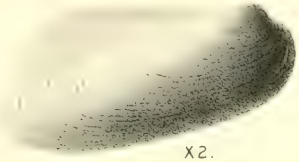
Figure 1. Side view of the only specimen that the writer has seen, from the Puntledge or Comox River, V. I., nine twelfths the natural size. The only place where any part of the siphonal region is preserved is at *a* (not A).

MODIOLA SISKIYOUENSIS (page 394).

Figure 2. Left valve of a small *Modiola* that is thought to be referable to this species, from Brennan Creek, V. I. Twice the natural size.

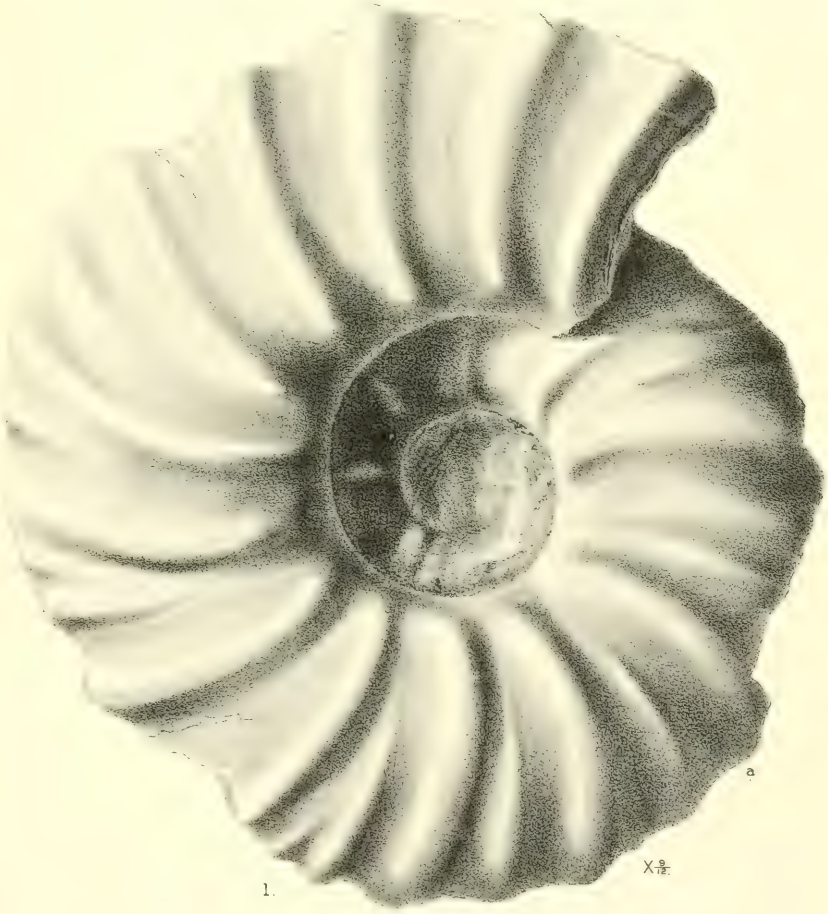
LITHODOMUS NITIDUS (page 395).

Figure 3. Side view of a specimen from the Nanaimo mines, shewing the right valve, and twice the natural size.



2. X 2.

3 X 2.



a

1. X $\frac{9}{12}$

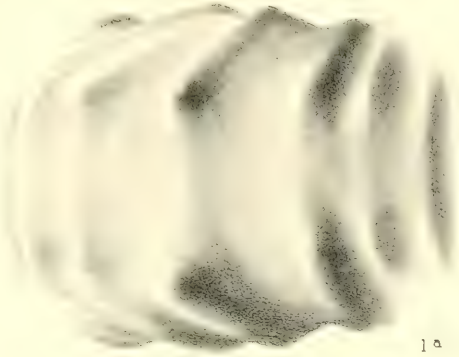
L.M.Lambe. Del^{t}

PLATE XLIX.

PACHYDISCUS BINODATUS (page 347).

Figure 1. Side view of the specimen from the Comox River collected by Mr. Harvey.

Figure 1 *a*. Peripheral view of a portion of the same, near the aperture, to shew the double row of nodes apparently characteristic of this species.



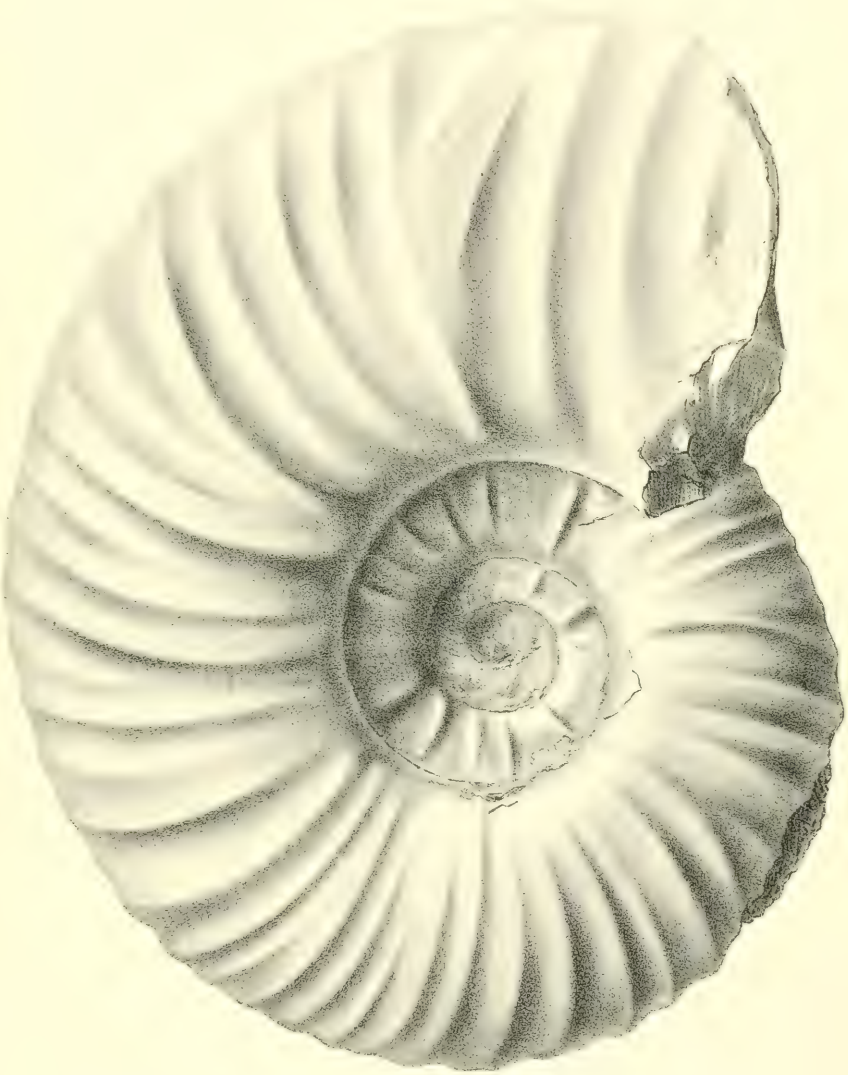
1a

1

PLATE L.

PACHYDISCUS MULTISULCATUS (page 349).

Figure 1.—Side view of the type of this species, from North West Bay, V. I., nine twelfths the natural size.



X $\frac{2}{12}$.

J. M. Lambe, Delt

PLATE LI.

HELCION GIGANTEUS? var. VANCOUVERENSIS (page 370).

Figure 1. Specimen from the Nanaimo River, V. I., as viewed from above.

LIMA SUCIENSIS (page 399).

Figure 2. Side view of a left valve of a specimen of this species, from the Sucia Islands. Twice the natural size.

RHYNCHONELLA SUCIENSIS (page 402).

Figure 3. The largest specimen that the writer has seen, from the Sucia Islands.

Figure 3 *a*. Front view of the same, to shew the amount of convexity of the closed valves, and the absence of a distinct mesial fold and sinus.

Figure 4. Portion of the ventral valve of another specimen, from the same locality, shewing the "narrow, prominent, acute raised ribs," supposed to be characteristic of this species.

TEREBRATELLA HARVEYI (page (403).

Figure 5. A ventral valve, from Extension mine, Nanaimo, V. I.

Figure 6. A dorsal valve, from Texada Island.

KINGENA OCCIDENTALIS (page 404).

Figure 7. Dorsal view of the specimen from the Trent River, V. I., described in the text.

Figure 7 *a*. Profile view of the same, to shew the proportionate convexity of the closed valves.

2.
X2
5.
3
6.
3a
7.
7a
X4.
4.
1

3 2044 072 170 293

Date Due

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